UNIVERSITY OF MICHIGAN
FEB 5 1952
ECONOMICS LIBRARY

JOURNAL of FARM ECONOMICS

•

CONTENTS

Output Responses of Farm Firms ..... *Willard W. Cochrane and William T. Butz* 445

The Measurement of Price Support Costs ..... *Karl Fox* 470

A Production Function and Marginal Rates of Substitution in the Utilization of Feed Resources by Dairy Cows ..... *Earl O. Heady* 485

Soil and Land Classification ..... *Charles E. Kellogg* 499

The Family Farm and the Three Traditions ... *Joe R. Motheral* 514

Problems in Wool Marketing Research ..... *P. L. Slagsvold* 530

•

THE AMERICAN FARM ECONOMIC ASSOCIATION
Volume XXXIII NOVEMBER, 1951 Number 4, Part 1

CONTENTS (*continued*)

NOTES

Farm Price Gyrations by Cochrane ..... *Theodore W. Schultz* 540

A Rejoinder ..... *Willard W. Cochrane* 545

Agricultural Output and Investment in Postwar Europe.. *Alexander Eckstein* 545

Some Problems in Marketing Research with Special Reference to Poultry Products ..... *W. P. Mortenson* 551

Possible Sources of Increased Agricultural Production ..... *Almon T. Mace* 557

Sampling Problems Related to the Study of the Appropriate Time to Market Fryers ..... *E. L. Baum and O. L. Brough, Jr.* 561

Testing Farm Business Analysis Factors by Correlation .... *B. R. Bookhout* 567

PUBLICATIONS RECEIVED 575

BOOK REVIEWS

Marion Clawson, Uncle Sam's Acres ..... *Raymond J. Penn* 577

E. Louise Peffer, The Closing of the Public Domain ..... *Raymond J. Penn* 577

Robert C. Ross, An Introduction to Agricultural Economics ..... *Robert L. Clodius* 579

Theodore Saloutos and John D. Hicks, Agricultural Discontent in the Middle West, 1900-1939 ..... *Dale E. Hathaway* 580

Calvin B. Hoover and B. U. Ratchford, Economic Resources and Policies of the South ..... *Adlowe L. Larson* 581

Robert E. Summers, Subsidies for Farmers ..... *Earl L. Butz* 584

United Nations, Measures for the Economic Development of Under-Developed Countries ..... *Lawrence W. Witt* 585

D. Gale Johnson, Trade and Agriculture, A Study of Inconsistent Policies... ..... *Robert B. Schwenger* 587

The Indian Society of Agricultural Economics, Readings in Agricultural Economics, Nature and Scope ..... *Philip M. Raup* 589

Reserve Bank of India, Land Mortgage Banks ..... *Philip M. Raup* 589

Sigmund von Frauendorfer, Relief Measures in Favour of Low-Income Farmers in Europe ..... *Philip M. Raup* 589

Erich W. Zimmermann, World Resources and Industries ..... *E. L. Baum* 591

NEWS NOTES 594

Price: $5 per year, this issue $1.25

Entered as second class matter at the post office at Menasha, Wis. Acceptance for mailing at a special rate of postage provided for in the Act of February 28, 1925, paragraph 4, section 412, P. L. & R., authorized November 27, 1931. Printed in U.S.A.

0
5
5
1
7
1
7
5
7
7
9
0
1
4
5

JOURNAL
OF
FARM ECONOMICS

Vol. XXXIII November, 1951 No. 4, Part 1

OUTPUT RESPONSES OF FARM FIRMS*

WILLARD W. COCHRANE** AND WILLIAM T. BUTZ
University of Minnesota and The Pennsylvania State College

I

THE theory of the firm, as it has developed in economic thought, is helpful in understanding and explaining the behavior of farm firms. But at various points that theory is poorly adapted to the nature of firm behavior in agriculture. For example, the aggregate output of a multiple-enterprise farm firm does not expand and contract as the presumed marginal cost curves of the individual enterprises might lead one to expect; expansions in the aggregate output of the firm would seem to be more closely related to farm technological advances than to the principle of variable proportions. Thus,the theory of the firm in agriculture has become circumspect.[1] Further, the question has been asked—How is the traditional theory of the firm[2] to be made compatible with a perfectly inelastic aggregate output function for agriculture on one hand, and commodity supply functions with some slope on the other?

The principal question to which we address ourselves in this paper is then—How does the farm firm respond to price changes? More precisely, we have in mind those output responses elicited in the short run (i.e., between seasons, but not between decades) in an essentially static frame of reference (i.e., without reference to expected prices or in terms of production plans over time). And, of course, we refer to output responses

* The authors wish to acknowledge the assistance given by W. L. Barr and K. R. Bennett of The Pennsylvania State College in many phases of the empirical inquiry; also the useful criticism of G. E. Brandow and C. V. Hess of the same institution. Errors of fact, judgment, or logic are, of course, the responsibility of the authors alone.

** The senior author was on the staff of The Pennsylvania State College when these ideas were put on paper.

[1] Walter W. Wilcox, "Effects of Farm Price Changes on Efficiency in Farming," *this Journal*, February 1951.

[2] George J. Stigler, *The Theory of Price*, Macmillan, pp. 156-159.

of *representative firms;* hence, the predictive value of our conclusions exists in a general or probability sense, not in particular cases.

The farm firm is our unit of inquiry, whether the number of enterprises is one or several. We cannot exclude from our thinking the multiple-enterprise firm because it does not lend itself to graphic analysis; neither can we exclude the single-enterprise firm because it may not seem to conform to theory. We seek a general formulation which provides a useful explanation of the output behavior of the farm firm, regardless of the number of enterprises involved. Our categories of analysis are in most instances the familiar cost elements of the firm, as well as the appropriate revenue concepts. But we shall not hesitate to develop and work with new concepts where they appear useful.

Our analytical method breaks into three parts: first, the formulation of an internally consistent theory (non-dynamic theory) of the firm in agriculture; second, an empirical investigation of the price-output behavior of a synthesized, representative dairy farm; and third, a brief appraisal of the theory of the firm in agriculture in the light of the limited empirical investigation.

II

The Aggregate Output Function of the Industry. There is a wide area of agreement with respect to the response of total farm output to price level changes. It is common for the total output of agriculture to expand in periods of high farm prices and general business prosperity; that is what occurred between 1937 and 1944. But the aggregate output of agriculture does not contract in response to falling farm prices; at least it has not in the twentieth century. That is what Sherman Johnson means when he says ". . . agriculture experienced a production revolution during the war years, and a large part of that change is irreversible." The aggregate output of agriculture surges forward when aggregate demand is expanding and technological advances are being made. But once the technological advance has spent itself, aggregate output settles down in a new fixed, sustained position. For example, the level of farm prices rose from 183 in 1944 (1935-39 = 100) to 266 in 1948, but the aggregate output of agriculture held constant at 137 to 138 on the index.[3]

These aggregative concepts were given greater precision by the senior author in the article "Farm Price Gyrations,"[4] where an index of the aggregate output of food was related to an index of "responsible prices"[5] over

[3] Index of production for sale and farm home consumption, BAE.

[4] *This Journal,* May 1947. See also, the later and more detailed presentation, *An Analysis of Farm Price Behavior,* The Pennsylvania State College Expt. Sta. Progress Report No. 50, May 1951.

[5] The term "responsible" is given to those prices current during the period in

the period 1912-1946. The plotted price-quantity points fall into a family of output curves; each curve is perfectly inelastic, or nearly so, for a given short run period; and each holds a fixed position so long as the index of worker productivity is constant.[6] But the inelastic aggregate output curves drift to the right when worker productivity increases. In sum, the aggregate output curves for food are perfectly inelastic (or nearly so) in the short run, because total productive resources do not flow in and out of agriculture in response to relative (farm-nonfarm) price level movements in the short run. The limits of our problem are thus defined.

The Aggregate Output Function of the Firm. The aggregate output function of the *industry* is the sum of the aggregate output functions of the *firms* comprising the industry. We define the aggregate output function of the firm as follows: the total output of commodities by a firm at varying prices (price indices). In a sense this is a hybrid concept; it is not a derivative of homogeneous sources. For example, the aggregate output function of the firm will not in most cases, but will in some cases, be identical with the marginal cost functions of particular enterprises. In all cases, however, it relates the total output of the firm to the price (or prices) received by the firm, assuming no change in the state-of-the-arts; hence, we have coined the special phraseology "aggregate output function of the firm" to distinguish it from other supply concepts.

On single-enterprise farm units the aggregate output function of the firm will be identical with the marginal cost function of the enterprise if, as accepted in orthodox theory, the marginal cost curve describes the output of the commodity forthcoming at varying prices. But we do not accept this logical presumption in all cases. In some cases, the output of a single-enterprise firm may fail to increase or decrease over a series of years, as the price of the product involved varies, in which case we would say that the aggregate output function of the firm is perfectly inelastic, or nearly so.

In a multiple-enterprise firm, the aggregate output function is clearly an index concept; it is not identical with or related in any way to the

---

which the production decisions were made that gave rise to the output forthcoming in the year in question. In that sense the prices are "responsible."

[6] Although the perfectly inelastic output curves referred to above were derived from time series data, where each observation is the intersectional point of demand and supply, no "problem of identification" in the Elmer Working sense (QJE, Nov. 1927) is involved here. We have every reason to believe that the aggregate output curves involved are true functional relationships—that is, a shifting demand function traces out for the *time period involved* the unknown supply function. This follows because we know the conditions of supply are unchanging during each *time period involved.* (For a full discussion see Sections II and III of Progress Report No. 50, *An Analysis of Farm Price Behavior,* The Pennsylvania State College Expt. Sta., May 1951.)

marginal cost curve of any one of the several enterprises. The aggregate output function of the firm describes in index form the total output forthcoming from all enterprises as the price index of the commodities involved varies. Conceptually then, the aggregate output function of the multiple-enterprise firm turns out to be a miniature of the aggregate output function of the agricultural industry.

If the aggregate output function of the firm is a conceptual miniature of the aggregate output function of the industry, we might expect the former to be perfectly inelastic as we know the latter to be. And if such is the case, our concepts are internally consistent and we have in a sense explained the perfect inelasticity of the industry concept. But the aggregate output function of the industry could be perfectly inelastic, where the aggregate output functions of some of the individual firms exhibited some elasticity. This would be the case where an increase in the output of one firm is offset by a contraction on the part of another.

It is our thesis, however, that the aggregate output function of firms in agriculture tends in the short run to be highly inelastic and perhaps perfectly so. This tends to be the case because most of the inputs for most of the firms in agriculture are fixed. The bulk of the productive agents—land, buildings, machinery and equipment, breeding stock, labor—on family farms are fixed in the farm by custom, long term contracts, and family ties. The intensity of resource use (the quantity of one input used where others are held constant) does not vary importantly, because of (1) customary practices in the community, (2) the purchase of equipment and land on long term contracts, and (3) the desire to provide for family members. But the cost of maintaining these agents goes on whether they are employed or not. Hence, they are employed and the output of the farm firm is maintained.

Now, it may be argued that any one firm may expand output by buying additional land and hiring additional labor; or contract output by selling or renting land and letting labor go or hiring out.[7] But we must remember that these are representative firms that we are talking about.[8] How, then, can each representative firm of an area (or an industry) increase in size in response to a rising price (prices) or decrease in response to a falling price (prices)? They can't do it by swapping among one another. They can do it only through bidding resources (mobile, variable resources) into the area (or industry), or by allowing them to be bid out. But we already know that resources do not flow readily back and forth across the farm-nonfarm

[7] D. Gale Johnson, "The Nature of the Supply Function for Agricultural Products," *The American Economic Review*, Sept. 1950.

[8] Our concept of a representative firm is precisely the same as that developed by Alfred Marshall, *Principles of Economics*, 8th edition, pp. 315-318.

line in response to relative price level movements: land can't, men don't, and investment funds do not appear to. Investment funds in agriculture, hence capital investments on farms, grow in the main out of surpluses accumulated in the long run on the farms involved.[9] Fertilizer is one of few truly variable inputs as far as agriculture as a whole is concerned; and through variations in fertilizer applications, representative firms can increase (or decrease) their total inputs modestly. But we conclude that the typical family farm—the representative firm in agriculture—cannot increase or decrease total output in response to rising or falling prices in the short run, except by very small amounts.

The concept of a highly inelastic output function for farm firms breaks down only where farming operations approach the factory type of organization—where inputs can and are varied, and cash costs are relatively important. We find examples of this factory type of farm organization in broiler production in the Delmarva area and in lettuce production in California.

The Multiple-Enterprise Firm as a Unit of Inquiry. The multiple-enterprise firm may be likened to the economy of a nation—a planned economy under the direction of one manager. The number, type, and combination of enterprises to be found in the economy of a firm depend upon a number of considerations: the working of the principle of comparative advantage; the supplementary relationship of enterprises, as in the use of labor over the season; the complementary relationship of enterprises; the location of markets, custom, and habit. The explanation as to why a Pennsylvania farmer in famed Lancaster County may combine such enterprises as dairy, poultry, beef fattening, potatoes, and tobacco on one farm has many facets. But of one thing we can be certain, the above five enterprises are not undertaken in combination because of some physical joint relationship existing among them, in which all must be undertaken in order for any one to exist. The five products mentioned are not produced in fixed and unvarying proportions.

On the contrary, each of the five enterprises mentioned is to some degree in competition with each of the others in the use of the total but limited volume of resources of the farm. And such is the case in western Iowa, where we might find such enterprises as cream production, hogs, beef, and poultry on the same farm; or in Colorado, where we might find

[9] We know, for example, that the value of farm machinery and motor vehicles used on farms, measured in constant dollars, increased 114 percent between 1940 and 1950. And our basic explanation for the expansion of the aggregate output function for the industry and the firm rests upon the investment in new technologies—farm technological advance. But these investments were financed primarily out of agriculture or institutions closely associated with agriculture (e.g., country banks, farm machinery representatives).

such enterprises as potatoes, sugar beets, beans, and beef fattening combined on the same farm. In all these cases, the enterprises combined on one farm are so combined because the manager feels the combination is a good one; possibly the combinations involved will yield a greater total output per total units of input than any other. Still, to an important degree, the enterprises are competitive—are in competition with one another in the use of the total resources of the farm.

Let us assume that our fictional, yet representative, Lancaster farm involving five enterprises—dairy, poultry, beef fattening, potatoes, and tobacco—is in both short and long run equilibrium for each enterprise. Short run average total costs and long run average costs are equal to average revenue for each enterprise at the minimum point of the cost schedules involved. Let us assume, next, that relative prices change—specifically, fluid milk prices rise and potato prices fall where other product prices are constant. This shift in relative prices would, we believe, induce the farmer to try to expand his dairy enterprise and contract the potato enterprise. The reallocation of resources on the farm might take the following form: (1) heavier feeding of the existing herd, (2) the retention for one more lactation period of a cow that otherwise would have been culled and the raising of an additional heifer, (3) the purchases of less fertilizer and spray materials and more feed concentrates, (4) the production of more roughage, and (5) the production of fewer acres of potatoes. More than one input has been varied per enterprise in this suggested program of resource substitution. But, in general terms, what we have is the following: a movement along the marginal cost curve of the dairy enterprise to that expanded output where marginal cost is equal to marginal revenue, and a contraction along the marginal cost curve of the potato enterprise to that contracted output where marginal cost is equal to marginal revenue. We have assumed here that the elasticity of the marginal cost schedules of each of these enterprises is greater than zero, an assumption that is eminently plausible in the light of known input-output relations.[10]

Although this analysis is conducted in an essentially static frame of reference, we should perhaps pay our respects to price uncertainty at this point. We would agree that to the extent the price changes assumed above were tinged with uncertainty, the production adjustments postu-

---

[10] If the product prices in all five enterprises fell proportionately, we would not expect to find a contraction in any of the five enterprises (i.e., the aggregate output function for the firm approximates perfect inelasticity). This condition grows out of the fixity of total inputs on the farm and means that the output which exists for each of the enterprises is no longer equal to that output where marginal cost equals marginal revenue. The hybrid concept is taking form.

lated would be slow to take place. In short and in general, price uncertainty must have a dampening influence on both short and long run production adjustments. That we assume to be the case throughout this discussion.

But to return to the hypothetical analysis of a Lancaster farm: the results are consistent with what we know (or believe we know) with respect to the configuration of individual commodity supply curves; they are positively inclined; more of each commodity is forthcoming at higher prices, less at lower prices. The results of this hypothetical analysis are also consistent with what we have postulated to be the case with respect to the total output of the farm. The total input of resources has not changed, and the efficiency of specific inputs probably has not changed importantly. Therefore, we should expect the total output of the farm to be approximately the same after the shift as before—that is, the aggregate output function of the firm may exhibit a slight negative slope, a slight positive slope or perfect inelasticity, but we would be surprised to discover any significant slope in the function.[11]

All is well to this point. Where the industry is made up of multiple-enterprise firms, a change in relative prices evokes production responses within firms consistent with positively inclined commodity supply curves and a perfectly inelastic aggregate output function for the industry. Resource substitution between enterprises, where total resources are fixed in amount, produces this result.

The question arises—How does the aggregate output of the firm and the industry vary? We should say that aggregate output of the representative firm in agriculture varies only in one direction—in an expanding action. And this expansion occurs through the farm adoption of a new technology, method, or practice (i.e., an innovation). We define innovation in the usual sense of the word: a new combination of inputs which causes the production function to shift upward. An innovation (synonymous with technological advance) may or may not involve a greater total outlay for inputs. But it must represent something more than a movement along a given production function; it must represent an upward shift in the function after any increase in total outlay is taken into account.

In practice it may be difficult to distinguish between an innovation and

[11] We are saying that an index of aggregate output, weighted by constant prices, will in this situation vary insignificantly. Where modest relative price changes induce resource shifts between enterprises, it follows that differences in the productivity coefficients for the enterprises involved must be small; for in those cases where the next best alternative is distinctly poorer, the productivity coefficient for that enterprise will be distinctly lower, and only an extreme relative price change will induce a shift. In the first instance, total output will not be changed significantly, and in the second instance, total output will not change at all, except in the case of a sharp change in relative prices.

a more intensive use of a variable (i.e., variable proportions). In practice we may have a continuum between these two classes of actions, for a more intensive use of a variable must in every case modify somewhat the practices involved. But at some degree of modification in practices and resource use, we must move from the area of variable proportions to one of a new combination. This zone of transition is reached, we argue, when a more intensive use of the variable forces a *marked* change in the practices or processes involved (e.g., high corn yields were obtained in the North Carolina experiments[12] under very heavy applications of nitrogen only after the number of plants per acre was increased from 4,000 to over 10,000).

But an innovation need not be forced upon us via the resource intensification route; most often they are not. Most often a new technological practice or innovation represents for the farmer concerned a discrete jump to a wholly new combination of inputs. An innovating act on the part of a producer represents a venture into the unknown, as far as he is concerned—from a combination of which he is relatively certain to a combination of which he is relatively uncertain. It turns out then that an innovation may not be defined in terms of physical practices or resource combinations, but only in terms of the state of mind of the individual concerned. An innovation has occurred whenever the new combination could not have been achieved within the confines of old modes of thought and habitual ways of doing things—when, in fact, a new configuration regarding the use of resources has taken shape in the farmer's mind.

We have in agriculture during periods of widespread technological advance: (1) the planning of new resource combinations (involving new sets of production functions) on many, many farms, and (2) the introduction of those new combinations between growing seasons as investment funds permit. And it may happen, as in the period 1937-44, that a new resource combination, involving new production functions, will be introduced on the same farms at the beginning of several consecutive seasons. In this case there is no movement along given production functions during the season or between seasons. *What we have is a shift from one fixed productive organization to another from season to season, so long as new technologies and investment funds are available.*

Our principal point, then, is that new resource combinations developed around a new technology, method, or practice provide the principal means of expanding the total output of the farm firm. This means that a perfectly inelastic aggregate output function for the industry shifts to the right when aggregate demand is strong and new technologies are there,

[12] *Fertilize Corn for Higher Yields,* North Carolina State College Expt. Sta. Bul. No. 366, June 1949.

rather than the emergence of a positively inclined aggregate output function.

The Single-Enterprise Firm as a Unit of Inquiry. It should be recognized at the outset that the single-enterprise, family-type farm with high fixed costs is not nearly so typical in agriculture as the multiple-enterprise unit. In fact, the pure and classic textbook case—the small, single-enterprise, family-type farm—is hard to find in many sections of agriculture. On one side it shades into the more typical multiple-enterprise type of firm, and on the other side it shades into the factory type operation with relatively large variable, out-of-pocket costs, as in the case of broiler production. Still we do find single-enterprise units in some areas and commodity lines: for example, wheat production on the Great Plains and fluid milk production in the Northeast. Thus, we must inquire into the output behavior of single-enterprise firms to fill out the theory.

If the agricultural industry were composed solely of single-enterprise units, and different type of enterprises were interspersed throughout the industry (i.e., single-enterprise dairy farms, wheat farms, hog farms and so on, were thoroughly mixed as in a garden salad), we would expect farm firms to behave in practice as they do on the blackboard. In short, we would expect single-enterprise firms to expand or contract along their marginal cost curves (the supply curves of the firms) in response to relative price changes. This would occur through the substitution of resources between *single-enterprise firms* in response to relative price changes, as was postulated in the case of multiple-enterprise units (although the institution of private property might be expected to slow down the process of substitution). Given a shift in relative prices, producers of favored commodities would expand along their marginal cost schedules by intensifying the use of variable factors obtained from producers of less favored commodities undergoing a contraction.

The rub is that agriculture is not organized in the manner described above. The agricultural industry is not comprised solely of single-enterprise units; for the most part it is comprised of multiple-enterprise units. And where single-enterprise units are to be found in numbers, we do not find an interspersion of different type enterprises. We find single-enterprise dairy farms in the Northeast and single-enterprise wheat farms on the Great Plains, but no mixture of the two. It is, however, common to find an intermixture of single-enterprise dairy farms and multiple-enterprise farms involving dairy in the Northeast, and an intermixture of single-enterprise hog farms and multiple-enterprise farms involving hogs in the Corn Belt. In sum, single-enterprise farm units tend to concentrate in a given type of farming area, and any significant interspersion of enterprises which exists, exists in the form of multiple-enterprise units

lying alongside single-enterprise units. But *the* enterprise of the single-enterprise farm tends to be ***the dominant*** enterprise on the neighboring multiple-enterprise farm.

If such is the structure of agriculture—what will be the output response on a single-enterprise unit to a price increase? To answer this question we must subdivide the single-enterprise, family farm into two basic types: (1) crop farms and (2) animal product farms. We hold to the general proposition that most of the agents of production do not vary on either of these basic types, hence the total output of each is unresponsive to product price changes. But the logic of this proposition rests on different grounds for the different type units; hence we will investigate each in turn.

Let us first take up the single-enterprise crop farm, of which wheat farms on the Great Plains may be considered a leading example. This would seem to be a clear and obvious case where total inputs per farm are fixed in the short run. In the first place, and for any given state-of-the-arts, such inputs as land, machines, labor, and seeds combine in nearly fixed proportions in crop production.

Although the lack of substitutability among different resources in crop production contributes to an explanation of unresponsive aggregate output on single-enterprise crop farms, it is not central to that explanation. The heart of the matter is to be found in the answer (or lack of answer) to the following question: How can the representative single-enterprise wheat farm increase its output in the short run, if the price of wheat rises for all producers in the area? Any one producer cannot expand his output by hiring or buying resources from his neighbor; his neighbor, too, will want to expand. And the resources will not be forthcoming from diversified units, for on those units managers will, within technical limits, be shifting resources out of other enterprises and into the wheat enterprise. Thus, we may not expect the output of single-enterprise wheat farms to be expanded by resource substitution within the Great Plains itself. Neither may we expect any important shift in labor and capital from other farming areas, or across the farm-nonfarm line, into the Great Plains.[13]

Our general proposition is, then, that the total resources of a single-enterprise crop farm are not usually varied in response to relative price changes. Consequently, output per farm does not respond to relative price changes. This means that the marginal cost curve, as the supply curve of the firm, is not *operative*. It exists in an experimental sense; it

[13] When physical factors permit, however, a single-enterprise firm may add new enterprises in response to a relatively unfavorable price for the single product formerly produced.

describes the additional cost per unit of output if and where variable inputs are added to the fixed combination of factors. But they are not added. The aggregate output function of the single-enterprise firm is perfectly inelastic, or nearly so, in the short run (this assumes, of course, average weather conditions).

We turn now to the single-enterprise animal product farm, of which dairy farms in the Northeast may be considered a leading example (this is the more difficult case and the one with which the empirical inquiry is concerned). The solution to this case differs from the foregoing because of the role of that important input, feed. Technically, feed is variable; technically, feed and livestock are substitutes for one another over a considerable range of output in the production of animal products. Further, feed grains and other concentrates do move between farming regions.

Fluid milk producers in the Northeast purchase grain and other concentrates in amounts varying from five to 25 percent of their total farm costs. And much of this purchased feed moves into the Northeast from the Midwest. A change in the relative prices of pork, poultry (eggs and meat), and fluid milk should then influence the amount of feed concentrates used in fluid milk production. To the extent that producers of fluid milk are acquisitive men, we would expect the output of milk—the total output of each farm—to vary somewhat as the input of feed concentrates is varied. And as a point of fact, we know that rates of grain feeding per milk cow increased during the 1940's.[14]

It is our contention, however, that the aggregate output of single-enterprise animal product firms is unresponsive to changes in product prices. We reason as follows: Animal product prices and feed prices tend to move in a parallel fashion and this relationship acts to restrict or shut off any tendency for output to vary. In other words, the most profitable level of production does not change when feed and product prices move up and down together.[15]

For example, fluid milk prices rise with an increase in general business

[14] In our opinion, the increased rate of grain feeding, which did take place over the decade of the 1940's, is more closely associated with technological advance than with variable proportions. Relatively high fluid milk prices and the expectation of continued high prices did induce heavier rates of grain feeding. But heavier rates of grain feeding tend to be a part of new practices involving new production functions. These new practices involve putting more total digestible nutrients through more efficient feed converters (i.e., cows), as well as the feeding of higher quality roughage. In fact, the increased feeding of concentrates during the 1940's, as an example of variable proportions, is incompatible with the constancy of milk-feed price ratios over the entire period: The milk-feed price ratio is lower in 1949 than in 1939.

[15] D. Gale Johnson develops a similar argument in his *Forward Prices for Agriculture*, p. 160.

activity and increases in personal disposable incomes. But given these conditions, other animal product prices will be rising too. There is a high degree of substitution among animal products, hence we should not expect to find milk prices rising sharply and distinctly relative to other animal product prices. We should expect to find all animal product prices advancing with increases in personal disposable incomes. In this context we should expect to find feed prices rising as all producers of animal products *attempted* to increase their output.

Milk-feed price ratios for the United States for the period 1939-49 bear out this line of reasoning. Those ratios[16] are:

1939	1.29	1945	1.42
1940	1.29	1946	1.38
1941	1.39	1947	1.18
1942	1.32	1948	1.26
1943	1.35	1949	1.28
1944	1.38		

Year to year variations do occur in this time series. There appears also to be a modest upward movement from 1942 through 1945 and a downward movement during the period 1946-47, but no trend is apparent over the entire period. *Certainly there is nothing here comparable to that great upswing in farm prices that took place over the period 1939-49.* The ratios hold relatively constant as feed and product prices rise together. A breakdown of these milk-feed price ratios by regions indicates more variation in some cases, less in others.

In short, we would argue that changes in the rate of profitability, growing out of changes in the milk-feed price relation, are not sufficiently large or of sufficient duration in most cases to cause dairymen on single-enterprise units to vary feed inputs, hence, vary output.[17] If such is the case on single-enterprise dairy farms, the aggregate output function must emerge as a trend line, perfectly inelastic or nearly so, connecting the intersectional points of marginal cost and marginal revenue as those two relations move up and down together.

But the aggregate output of single-enterprise firms does change-

[16] *Rations Fed to Milk Cows*, BAE, USDA, annually, 1945-50.

[17] The question might be asked—How does the known variation in hog production associated with the hog-corn price ratio fit into this analysis? Fortunately, it does not cause us much trouble. The variation in hog production associated with variations in the hog-corn price ratio occurs primarily on multiple-enterprise farms where resources can and are readily transferred. The resource shifts, which give rise to the hog cycle, occur in large measure on farms where less than 40 percent of their gross receipts come from the sale of hogs and alternative opportunities for resource use are good and close. (See the BAE study, *An Explanation of Factors Motivating Farmers in Their Production and Marketing*, processed, 1947.) In sum, the hog cycle is not a phenomenon of single-enterprise units.

expand—through time. Customary patterns of resource use and levels of output are disrupted from time to time by the farm adoption of technological developments. In periods of rising product prices, favorable income expectations, and the existence of a new technology, we may expect that new technology to be invested in, a new resource combination to evolve, and an expansion of total output to result.

A Generalizing Statement. Our system is internally consistent. Changes in relative prices induce resource shifts on multiple-enterprise firms. These resource shifts cause the quantities of different commodities produced on multiple-enterprise units to vary and the market supply curves of the commodities involved to be positively inclined. But the aggregate output on both multiple and single-enterprise units does not vary with price (or price level) changes. The perfectly inelastic output functions for individual firms are consistent with the perfectly inelastic output function of the industry. Finally, the aggregate output function of the industry drifts to the right as technologies are incorporated into individual productive organizations and the aggregate output functions of individual firms expand.

III

The Representative Dairy Firm. The single-enterprise dairy farm, with which we shall be working in this section, was constructed from records available on 15 farms in two counties (Wayne and Lackawanna) in northeastern Pennsylvania. On each of these farms, 90 percent or more of the cash receipts were derived from the sale of fluid milk in 1941-42.[18] The data available from these 15 farms were used as the principal guide in (1) synthesizing the physical organization of the firm, and (2) determining the customary practices of dairy producers in this area. Thus, our firm does not actually exist and never did exist, but it is representative of single-enterprise dairy farms in the area. If dropped from the sky into Northeastern Pennsylvania, it would be described as a typical single-enterprise unit as regards size, organization and practices.

The Physical Organization of the Representative Firm. We cannot here enter into a discussion of the methodology involved in constructing the physical organization of this firm.[19] And we can present only briefly the

[18] The principal source of data was the 1941-42 study, *Costs of Producing Milk in Pennsylvania,* see Experiment Station Bulletin No. 467 of the same name. But each of these farms was visited during the course of this study, and information was obtained on these farms from such additional sources as milk dealers and later surveys.

[19] For an explanation of methods used and a complete description of the physical and financial organization of the representative farm, see the doctoral dissertation by William T. Butz entitled, "The Adaptation of the Theory of the Firm to the Operation of a Single-Enterprise Dairy Farm in Northeastern Pennsylvania," The Pennsylvania State College, 1951.

principal features and relationships of its physical organization. But we should remember that the physical components of this firm are (1) representative of the area, and (2) conceptual parts of an integrated whole–a going concern.

The 90 acres of land comprising the farm business and the farm home include 36 acres in crops, 48 acres of permanent and woods pasture, and six acres in the farmstead, fence rows, roads and waste or idle land. Cropland consists of six acres of corn for silage yielding 56 tons, six acres of oats yielding 189 bushels, and 24 acres of hay yielding 36 tons of mixed hay (clover and timothy) from one cutting. A cropping system in which hay is left down four years is practiced. The 48 acres of permanent and woods pasture are equivalent to 28 acres of "average"[20] open pasture. Seven acres of hay are pastured after the crop is removed.

The labor force, made up of the owner-operator, unpaid family labor and hired labor, works a total of 20.9 man equivalent months. This total consists of 12.0 months by the operator, 6.0 months by other members of the family, and 2.9 months by hired hands.

Fourteen grade Holsteins are on hand at the beginning and end of the inventory period, with an average of 13.3 cows kept during the year. Herd replacements are home raised and are in sufficient number to maintain the size of the herd. Other livestock includes a grade Holstein bull and two horses.

Each cow produces 6,560 pounds of four percent milk during a 302 day lactation period. During the year the cow is fed 5,834 pounds of total digestible nutrients (T.D.N.), of which 5,786 pounds are consumed during the lactation period and 60-day dry period.[21] Total digestible nutrients obtained per cow from the different kinds and quantities of feed consumed in 365 days are: 1,700 pounds from 2.0 tons of hay; 1,157 from 3.4 tons of corn silage; 1,468 from 1,957 pounds of mixed dairy feed; 1,509 pounds from permanent and aftermath pasture. The maintenance ration, based on a 1,100 pound cow, is 3,156 pounds of T.D.N. during 362 days. The residual, 2,630 pounds, represents the pounds of T.D.N. fed above maintenance during 362 days.

Two kinds of power equipment are owned–a tractor and a truck. Included among the more important pieces of other equipment are: plow, harrow, mower, rake, drill, binder, cultivator, wagon, and miscellaneous specialized dairy equipment.

Financial Statements of the Representative Firm. We now recast the

[20] An acre providing 75 animal unit grazing days or 1,200 pounds of T.D.N. during the pasture season.

[21] The production function derived later on does not include input or output data for the first three days after calving, the colostrum period. In this we follow the procedure of the U.S.D.A., Technical Bulletin No. 815.

physical organization of the representative firm in value terms (1941-42 dollars). Total investment in the farm business, based on average inventory values, amounted to $7,329. Real estate and livestock represent the largest investments, accounting for 58 percent ($4,322) and 27 percent ($2,001), respectively. Investments in equipment totaled $966, and in feed and supplies, $40.

The net cost to be associated with the estimated output of the representative firm is $2,367, this being the difference between gross costs of $3,008 and credits of $641. The net amount consists of $1,810 in fixed costs and $557 in variable costs.

All costs other than that of purchased concentrates for cows are considered "fixed." Hence, in addition to the costs customarily classified as fixed, we include such expenses as operating costs of power equipment ($93), repairs and purchases of other equipment ($80), seed and fertilizer costs ($79), concentrates purchased for livestock other than cows ($55) and *all* labor expenses, imputed and direct ($1,622).[22] We should be the first to admit that certain expenses included here as fixed are not fixed in either a practical or theoretical sense. The strictures of a graphic analysis *and the paucity of physical input-output data* force this classification. However, the bulk of the "fixed" costs are constant in the technical sense of the term (i.e., the inputs cannot for physical or institutional reasons be varied in the *short run*). But more importantly, practically all the expenses within our "fixed" category are customarily treated as fixed costs in the area involved.

The really important variable input of the area, grain fed to cows, we have classified as a variable. We assume also that all grain fed is purchased.[23]

The Production Function of the Representative Firm. The total product curve of Figure 1 states a relation between the output of milk (four percent F.C.M.) per cow and inputs of T.D.N., when inputs of T.D.N. are varied and all else is held constant. It needs to be pointed out that the input of T.D.N. in this instance is varied by varying the amount of concentrates fed. The total amount of roughage produced on the representative farm cannot be varied in the short run. Hence, the composition of the total ration fed per cow varies over the range of feeding inputs. But the range of feeding inputs is limited to that where, in the opinion of dairy

[22] Family labor costs were estimated primarily on the basis of opportunity costs, i.e., what it would have cost the operator to have hired a person to come to the farm and assume the same responsibility of labor and management and be supplied with the same privileges.

[23] Of the 15 farms observed, 12 purchased all of the concentrates fed to cows. On the three other farms, purchased concentrates accounted for 84 to 93 percent of the grain fed to cows.

technologists, grain and roughage are perfect or near perfect substitutes for one another in the provision of T.D.N.

It should be obvious to all concerned that the 15 operators of single-enterprise farms on which records were taken in 1941-42, and from which the representative farm was constructed, did not vary their inputs of T.D.N. for the benefit of the record takers. In short, the production function of Figure 1 could not be developed from the type of information

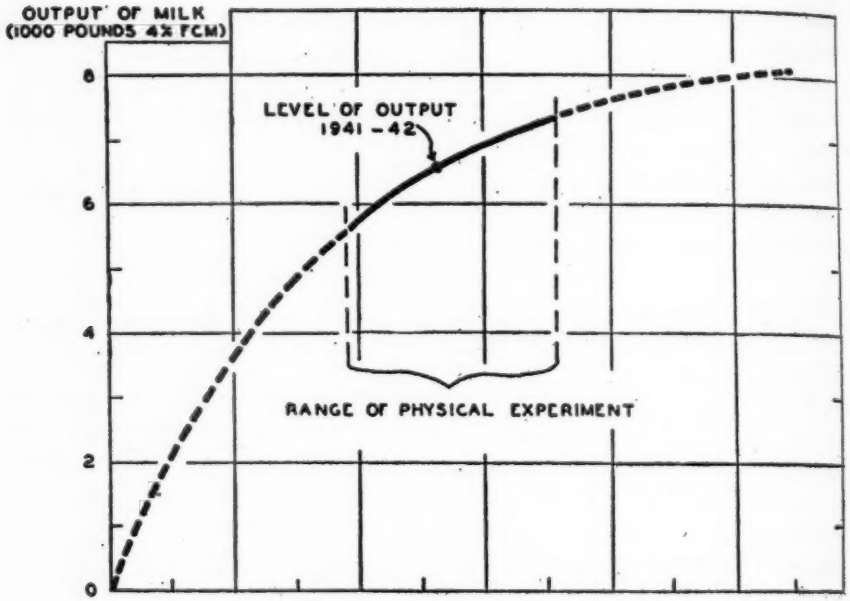

FIG. 1. TOTAL PRODUCT FUNCTION, PER DAIRY COW, REPRESENTATIVE FARM

obtained in the Pennsylvania study of 1941-42. It was derived from input-output data obtained in the well known investigation of input-output relationships in the production of milk conducted by the U. S. Department of Agriculture in cooperation with 10 State Experiment Stations.[24] Since feeding experiments were conducted with, and product functions derived for, different grades of cows in the U.S.D.A. study, we were able to pursue our inquiry along the following lines. First, compare the quality of cows milked on the representative farm with the different quality classes experimented with the U.S.D.A. study. Second, if it were

[24] Einar Jensen, et al., *Input-Output Relationships in Milk Production*, U.S.D.A. Technical Bulletin No. 815, May 1942.

ascertained that the cows milked on the representative farm were similar in efficiency and capacity to one of the classes experimented with in the U.S.D.A. study, the product curve of that class could be used as the product curve of cows on the representative farm. And it was determined that the cows of the representative farm were similar in quality to those classified in the U.S.D.A. study as "low stations–poor cows." Hence, with one minor adjustment the production function for "low stations–poor cows"[25] becomes the production function for each cow on the representative farm.

The generic formula for this function is:

$Y = A(1 - r^x)$ when

Y = hundredweight of four percent F.C.M. produced during 302 days.

A = a constant representing the asymptote of the function, even though it may be impossible to feed a cow enough to reach this maximum output.

r = a constant representing the ratio of increments of output associated with equal absolute increments of input.

x = hundredweight of T.D.N. above maintenance during 362 days.

For some unexplained reason, the values of A and r are not given in the U.S.D.A. study for any of the production functions. But by a series of approximations, the values of A and r for the "low stations–poor cows" class were determined to be 86.5 and .945 respectively. As might be expected, the U.S.D.A. production function for the "low stations–poor cows" group does not provide a perfect fit of the experimental observations. And neither does it pass through the coordinates of the known input-output observation for the average cow milked on the representative farm. But we assume that the observation for the representative farm, as of 1941-42, varies from the U.S.D.A. function for the same reason that cows in the experiment did (i.e., uncontrolled variation).[26]

The U.S.D.A. "low stations–poor cows" production function was then adjusted–lowered–to pass through the observed point of the representative firm. The adjusted curve is that presented in Figure 1 and defined as the production function of each cow kept on the representative firm. Total output of the firm is a multiple of this relationship. The value of A for this curve is reduced to 84.7, but r remains the same.[27]

[25] Ibid., page 42, Figure 14.

[26] See footnote 27, for a measure of discrepancy.

[27] The adjustment in output necessary to lower the function to the coordinates of the input-output relationship existing in 1941-42 could have been achieved by altering both constants, A and r. From the data available with which to estimate the values of A and r in the U.S.D.A. function for "low stations–poor cows," little statistical significance could be attached to numbers beyond the third digit in either constant. A change of two percent in the value of A (from 86.5 to 84.7) affected estimated output by the same amount as a change of .03 percent in the value of r. Since a .03 percent change would not alter the third digit of r, any additional precision in the formula had to be acquired through an adjustment in A.

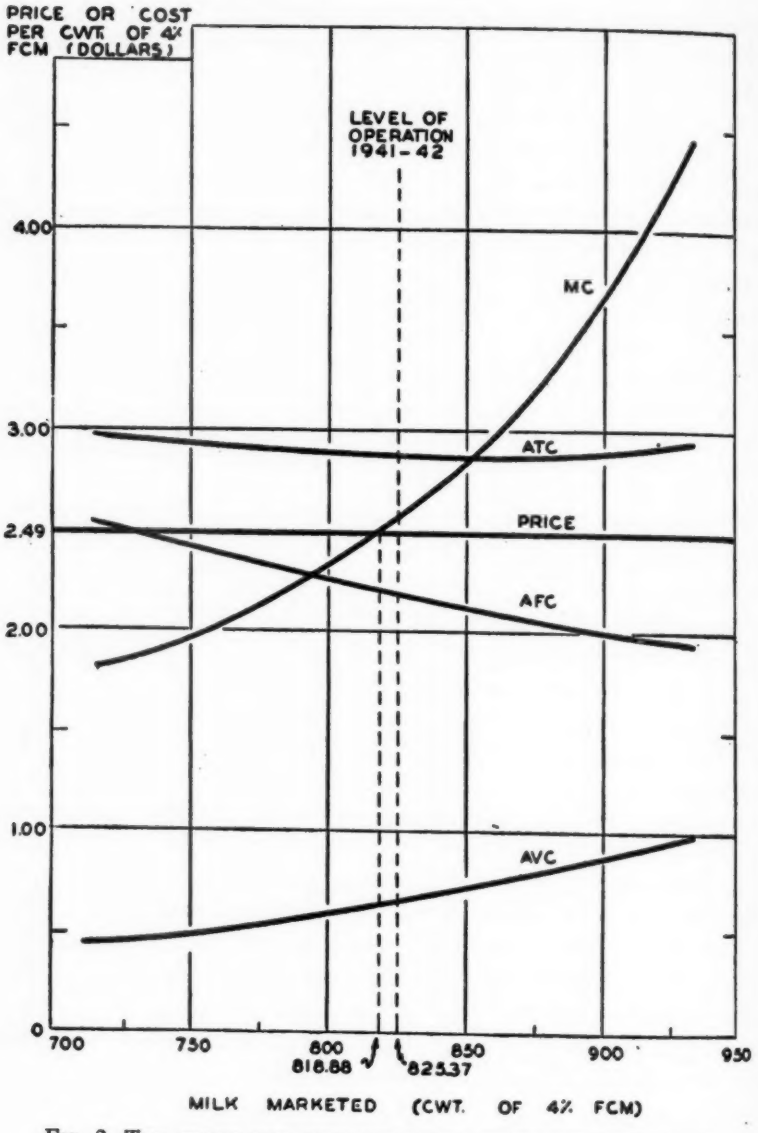

FIG. 2. THE SHORT RUN COST STRUCTURE, REPRESENTATIVE FARM

The Cost Structure of the Representative Firm. We derive in a conventional manner the short run cost structure of the single-enterprise dairy farm from the product curve described in Figure 1 and the factor data summarized in the financial statements and the physical organization of the farm. This cost structure is presented in Figure 2.

We observe that the cost of producing a hundredweight of milk (four

percent F.C.M.) at the level at which the representative firm operated (825 cwt.) in 1941-42 was \$2.868.[28] We further observe that the representative firm was operating close to, but not up to, the short run minimum cost position (ATC = \$2.865 at an output of 849 cwt.); and it was operating close to, but just beyond, the maximum profit, or minimum loss, position (M.C. = \$2.49 at an output of 819 cwt.). In other words, given the cost-price relationships described in Figure 2, the representative firm is operating as near the optimum as one could reasonably expect. It would seem that managers of single-enterprise, family-type dairy farms in northeastern Pennsylvania had achieved through trial and error a farm organization designed to produce milk at minimum cost in 1941-42. The fact that minimum costs per unit (\$2.87) exceed price (\$2.49) did not come as a shock to the authors; farm operators traditionally overvalue their productive effort in agriculture.

Perhaps the most interesting idea that emerges from Figure 2 is the wide range in output over which the cost of producing a hundredweight of milk (four percent F.C.M.) does not change to any important degree. The average total cost of producing milk is \$2.97 at 716 cwt., \$2.87 at the minimum cost position of 849 cwt. and \$2.93 at the upper limit of 933 cwt. In a somewhat superficial, but nonetheless important sense, the explanation for this tendency toward constant costs in the short run is to be found in the set of circumstances where the decline in average fixed costs is closely offset by the rise in average variable costs.

Output Responses of the Representative Firm. The volume of milk (four percent F.C.M.) marketed by our firm by months from May 1941 through April 1944 is shown in Figure 3. This case history was synthesized, as was the farm itself, from the available records on 15 dairy farms in Wayne and Lackawanna Counties in northeastern Pennsylvania. And the *available* records in this case were limited to 10 farms. Thus, the base output of the representative farm of 825 cwt. for 1941-42 is distributed throughout that year and extrapolated through 1942-43 and 1943-44 in accordance with a weighted average of the milk marketed by 10 farms for which records were available.[29]

---

[28] In addition to the 825 cwt. marketed, a total of 47 cwt. was used in the home and fed to calves. Thus total output was 872 cwt. of four percent milk. This quantity was corrected from 910 cwt. of 3.7 percent milk. The average total cost of producing a hundredweight of 3.7 percent milk on the representative farm at the level of output was \$2.60. This compares with a cost of \$2.56 computed by the "enterprise approach for the same 15 farms in the 1941-42 study, *Cost of Producing Milk in Pennsylvania.*

[29] The volume of milk marketed by months, from May 1941 through April 1942, is based on the operations of 15 farms. These data were available from the previously cited study, *Cost of Producing Milk in Pennsylvania.* For the two years, 1942-43 and 1943-44, the quantities marketed were furnished by milk dealers. Data could be obtained for only 10 farms, and of these, the data for three farms were discarded because of incompleteness.

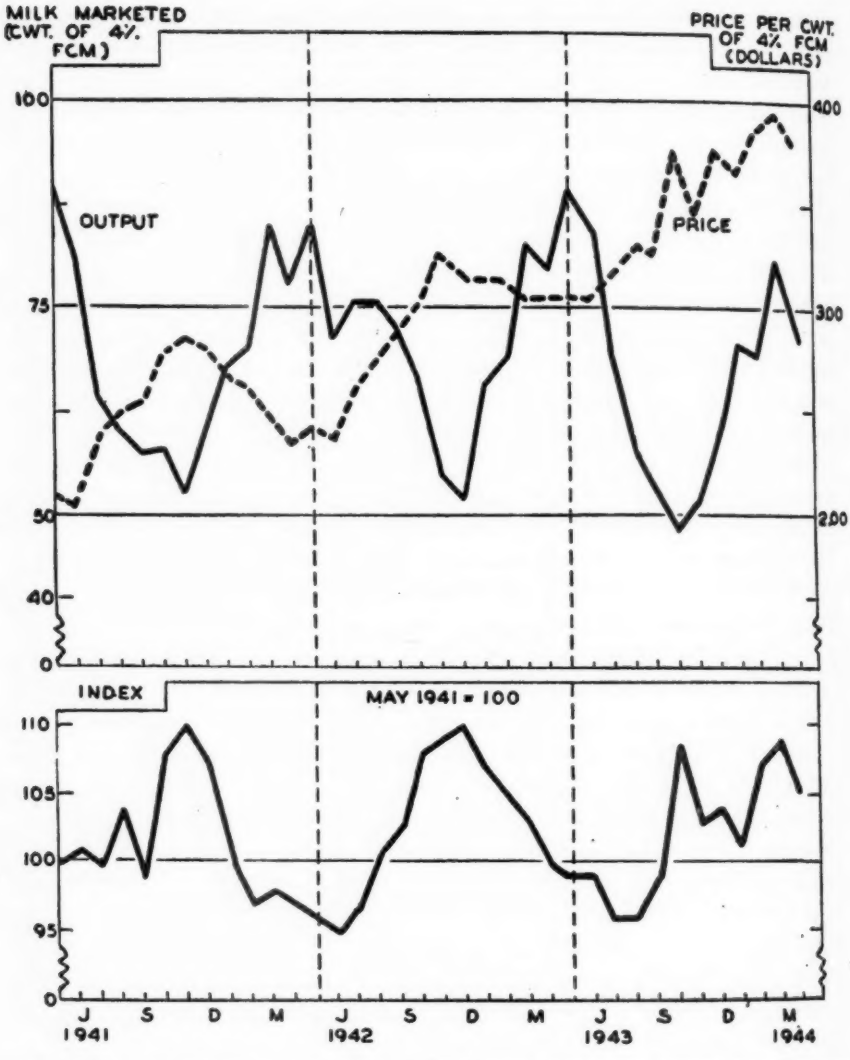

FIG. 3. PRICE-OUTPUT SERIES OF REPRESENTATIVE FARM AND INDEX OF MILK-FEED PRICE RATIO, BY MONTHS, MAY 1941-APRIL 1944

The seasonal pattern of milk production stands out clearly in Figure 3. But we do not observe any distinct trend of expansion or contraction over the three-year period. The volume of milk produced and marketed by the representative firm shows a tendency to increase between the first and second years and decrease between the second and third years. On an annual basis, milk output moves up from 825 cwt. in 1941-42 to

851 cwt. in 1942-43, and then drops back to 808 cwt. in 1943-44. Some of this decline is 1943-44 may have been due to four months of unusually dry weather during the growing season of 1943. In other words, the greater than average seasonal decline in 1943-44 may be associated with climatic factors rather than with economic factors. If this were the case, we should perhaps consider output to be constant, or nearly so, over the period involved. And even if we ignore the weather factor, output declined no more than five percent between the high of 1942-43 and the low of 1943-44.

The blend price of milk received by farmers in northeastern Pennsylvania increased steadily over the period involved. The average annual price of milk received *at* the representative farm rose from $2.49 per cwt. in 1941-42 to $2.88 in 1942-43 and on to $3.49 in 1943-44. If we relate these prices to the short run cost structure of Figure 2, the outputs which would equate marginal revenue and marginal costs are 819 cwt. in 1941-42, 854 cwt. in 1942-43, and 893 cwt. in 1943-44. The output solution of 853 cwt. for 1942-43 compares favorably with the estimated actual output of 851 cwt. But, as we know, the output of the representative firm declined in 1943 -44 instead of rising. Or more properly stated, the output of the representative firm showed no tendency to expand over the three-year period. The first point to be made is then the following—the continuous and *absolute* increase in the price received for milk *at* the representative farm failed to induce a continuous expansion of output.

But what was happening to relative prices over this period? We get a limited view of relative price movements in the lower chart of Figure 3. Comparing the price of milk with the price of feed through the milk-feed price ratio we observe that the ratio hovers around 100 over the three-year period. And since we know that both milk and feed prices were rising in that period, we conclude that they were rising in a roughly parallel fashion.

We obtain a better explanation of output behavior when rising factor costs are taken into consideration. Short run cost structures of the representative firm for the years 1941-42, 1942-43, and 1943-44 are presented in Figure 4. The increase in marginal costs is due solely to the increase in feed prices. The increase in average total costs is due primarily to rising feed costs. But we have also taken account of those out-of-pocket fixed costs which did increase and which, of course, influence the level of the average total costs.[30] In this category were such items as: real estate repairs, seed, fertilizer and lime, power equipment operating costs,

[30] In using the theory of the firm as a predictive device, only marginal costs are relevant—fixed costs need not be adjusted for factor cost changes. But in this study, out-of-pocket "fixed" costs were adjusted to make the analysis more realistic.

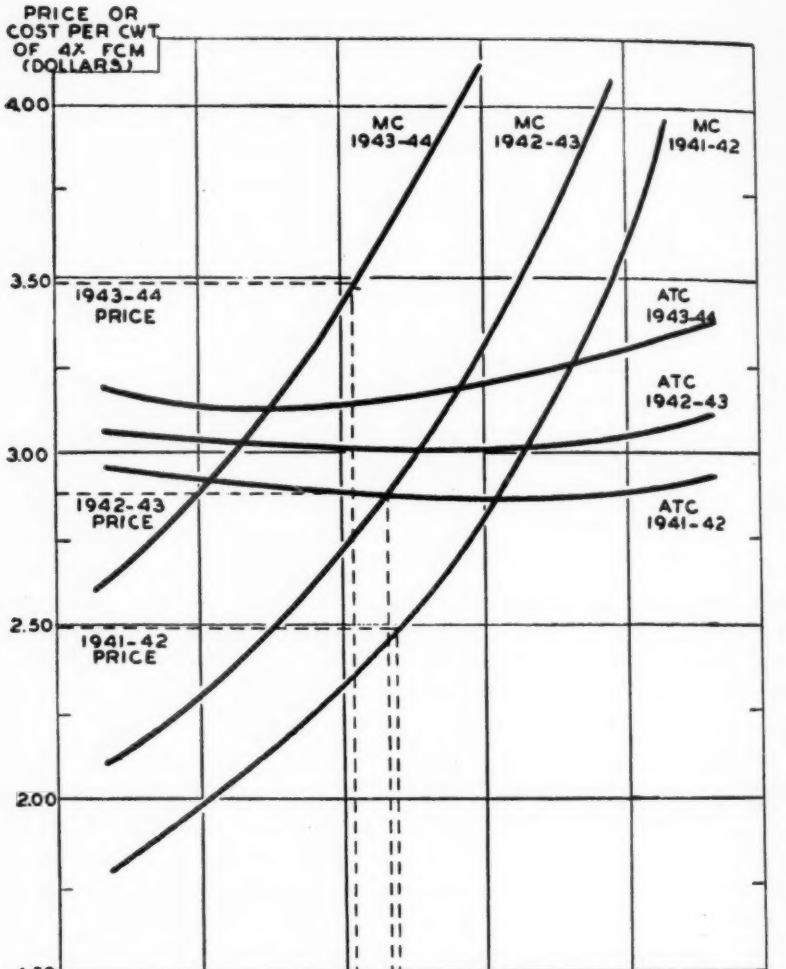

FIG. 4. OPTIMUM OUTPUT POSITIONS, REPRESENTATIVE FARM, 1941-42, 1942-43, 1943-44

hired labor, and miscellaneous expenses. In brief, the short run cost structure rises as out-of-pocket costs (variable or fixed) rise;[31] imputed

[31] Data on factor cost changes were obtained from the study by G. E. Brandow

costs to fixed factors are held constant. The principal item purposely passed over in this connection is the value of the operator's labor and management.

We observe from Figure 4 that the optimum output position of the representative firm, as indicated by the intersection of marginal cost and marginal revenue, declines modestly over the three-year period. Those income maximizing output positions are:

	(Cwt. of 4% F.C.M.)
1941-42	818.88
1942-43	816.05
1943-44	804.26

These optimums compare with the estimated actual output of the representative firm as follows:

	Estimated actual output (Cwt. of 4% F.C.M.)	Percentage variation of optimum actual
1941-42	825.37	— .78
1942-43	851.45	—4.16
1943-44	807.71	— .43

We see that optimum and actual outputs are *very close* in 1941-42 and 1943-44. But in 1942-43 actual output exceeds the optimum by some four percent. We have no ready explanation for this variation. We can suggest two possible explanations: (1) the patriotic motive; (2) the product price illusion. By the latter we mean, the producer was induced by higher milk prices to feed more heavily and so expand output. But in due time he felt the impact of rising feed prices and curtailed output. But even with this output deviation in 1942-43, the rising cost structures of Figure 4 provide a reasonable explanation of output behavior over the period 1941-44. The rise in feed prices so paralleled the rise in milk prices *over the entire period* that no expansion in milk production was warranted.

Two additional points need to be made with regard to the operations of the representative firm. First, the profitability rate moves from a negative to a positive value over the three-year period. Losses, which stood at 38 cents per cwt. for four percent F.C.M. in 1941-42, are reduced to 13 cents per cwt. in 1942-43 and happily are converted into profits of 32 cents per cwt. in 1943-44. If, however, the value of family labor had been adjusted, these "profits" would have been wiped out. Second, the representative firm was subject to almost constant costs over its effective range of operation. Average total costs over the range in output 790 cwt. to 861 cwt. varied at a maximum by only 2.1 cents in 1941-42, by

and D. C. Kimmel, *Prices Paid by Pennsylvania Farmers, for Commodities and Services Used in Production, 1935-47*, Bul. 500, Agr. Expt. Station, Pennsylvania State College, May 1948.

only 1.3 cents in 1942-43 and by 6.2 cents in 1943-44. With costs so nearly constant over the effective range of operation it would, indeed, be difficult to hit on the optimum level of output.

IV

Behavior of the Representative Firm. Without question, the behavior of the representative firm in the foregoing empirical analysis was such as to be consistent with and lend support to the traditional theory of the firm. The empirically derived marginal cost curve fits our theoretical conception. The estimated actual output in the base period, 1941-42, closely approximates the optimum output position. And the production responses of the representative firm between 1941 and 1944 are eminently reasonable in terms of the theory of the firm.

The upward floating structure of costs and revenues between 1941 and 1944 suggests that the aggregate output of the representative firm should have declined modestly in each year of the three-year period (i.e., the suggested aggregate output function has a slight negative slope). For the entire period the estimated actual output of this firm closely approximates the suggested optimum levels of operation, although the actual output deviates from the optimum in the middle year, 1942-43. But we would argue that this deviation is not worrisomely large, and on balance the representative firm behaves as the theoretical model suggests.

Implications for the Theory of the Firm in Agriculture. The empirical inquiry was limited to one of the three cases developed in the general theoretical formulation. Thus, our theory of the firm in agriculture was subject to only partial empirical verification. It was tested only with reference to the animal product type of single-enterprise farm. We submit, however, that the limited, but nonetheless time-consuming inquiry presented in Section III substantiated, as far as it went, the general propositions of Section II.

It should perhaps be pointed out that the area and period involved in this inquiry were not purposively selected; we used secondary data collected in a prior survey—the 1941-42 survey, *Costs of Producing Milk in Pennsylvania.* But the data for single-enterprise, dairy farms in northeastern Pennsylvania, 1941-44, bear out our theoretical formulation as to the behavior of single-enterprise, animal product farms. All animal product prices, including fluid milk prices, move up with increases in personal disposable incomes. In this situation the flow of feed between regions is not distorted from its longer run pattern. It is not, because all producers of animal products are trying to increase their outputs. Consequently, feed prices rise generally and push up the cost structures of animal product farms. Rising cost structures shut off the expansion of

output on individual farms and give rise to output functions which tend to be perfectly inelastic.[32]

The general propositions set forth in this paper need to be tested again and again in varying situations. But we would argue that the empirical analysis is consistent with the general formulation. And until more evidence is in, we shall hold to the following propositions: the aggregate output function of a representative commercial, family farm, whether a single or multiple-enterprise unit, is perfectly inelastic or approximately so; but this inelastic aggregate output function shifts to the right as technological developments are adopted on farms.

[32] The sympathetic reader may in retrospect be troubled by the time period (or length of run) to which the aggregate output function of the firm refers (we don't anticipate that the unsympathetic reader got this far). Clearly the aggregate output function for the firm and the industry relates to a period in which technological advance is absent. Secondly, it does not relate to the long run, which in agriculture must represent a non-existent period, wherein all factors can be varied and the state-of-the-arts is unchanged. It emerges as a concept for us in that period during which factors that are typically varied are varied or could be varied if conditions warranted. Such a period is generally defined in economics as the short run: in the empirical analysis this period covers three years; it might be longer or shorter depending on the circumstances of the situation.

THE MEASUREMENT OF PRICE SUPPORT COSTS*

KARL FOX
Bureau of Agricultural Economics

EVER since 1929, price support activities have been a central element in our farm program. From decade to decade, basic research, soil conservation, and education may be more fundamental to the improvement of agriculture and rural life, but from year to year, price support has been the major, and at times the most controversial, expression of public policy in the field of agriculture.

During World War II, price support commitments were greatly extended under the Steagall Amendment,[1] designed to stimulate production. The actual cost of meeting the Steagall commitments after the war, with inflation at home and famine abroad, proved small. But the contingent liability of Government in the event of a sharp drop in demand had been substantial, particularly on livestock products. The record harvest of 1948 also raised fears in some quarters as to the cost of supporting crops.

Secretary Brannan's statement of April 7, 1949 injected several new elements into the discussion of price supports. Among other things, he suggested a new formula for establishing price support levels and stressed the use of production payments to meet price support commitments on perishables. Others were advocating direct supports, some at higher and some at lower levels. As a result of these various proposals and the background of concern already existing, the question of program costs—specifically, costs to Government—assumed central importance in public discussion prior to Korea. Though of secondary interest at the moment, this question is likely to reappear in the future.

At various times since 1946, the author has considered the problem of estimating price support costs and has set down a number of notes for his own use. This article summarizes some of these notes which are relevant to the estimation of price support costs and benefits in a peacetime setting. But some introductory comments are in order.

The analytical framework presented here is focused rather narrowly upon the measurement of cash benefits to farmers, cash costs to consumers and cash costs to Government resulting from given sets of price support operations. The pattern of farm prices and consumer expenditures in the absence of price support is chosen as the zero point from which cash

* The views expressed in this article are those of the author and are in no sense official findings of the agency in which he is employed.

[1] Section 4 of the Act of July 1, 1941, as amended, 15 USC 713 a-8. This section remained in force until December 31, 1948. Many of the Steagall supports were continued through 1949 under Title I of the Agricultural Act of 1948.

costs and benefits are to be measured. This choice of basing points has no normative significance. If we are interested only in differences between programs rather than in actual costs of each, other basing points are equally acceptable.

The role of price support programs in directing production is not specifically included in this frame work. The presentation is simplified by assuming that production is the same, regardless of the level and method of price support chosen. However, when the framework is used for numerical calculations we can readily insert different production estimates for different programs. Lying back of these differential production estimates is a body of statistical and *a priori* supply analysis exactly parallel to the body of demand analysis referred to in footnote 5 below. A realistic appraisal of the costs of alternative price support programs over a period of years clearly requires estimates of their short run and cumulative effects on production as well as upon domestic and foreign demand.[2]

An important function of price supports on storable commodities is to even out the time-distribution of income to farm families. Various arguments can be advanced in support of the proposition that a fall in income to 50 percent of average involves a loss of welfare which is not compensated by a subsequent rise of income to 150 percent of average. We might simply postulate a diminishing marginal utility of income, although this is a pale reflection of the realities involved. So long as the welfare-income function is convex upward, as this postulate implies, total welfare over a period of years will be smaller if income fluctuates than if the average income is realized every year. Wide fluctuations will result in less total welfare than moderate fluctuations. But quantification of gains from increased stability will not be attempted here.[3]

A Framework for the Measurement of Price Support Costs

1. The issues involved in price support policy cannot all be measured in dollars and cents. But a number of them are subject to measurement,

[2] The reader's attention is called to the article by George Mehren on "Comparative Costs of Agricultural Price Support in 1949," which appears in the recent Proceedings Number of the *American Economic Review* (May 1951, pp. 717-746). Dr. Mehren's numerical calculations cover a narrower range of variables than are provided for in the framework outlined here, and the results are highly particularized to 1949 conditions. But the text discussion is much broader than the title would suggest (see especially pp. 741-746).

[3] There are important sources of variation in the incomes of individual farmers which cannot be offset by price support, and various types of insurance and credit have been developed to shift the time-distribution of their impact on family living. But few farmers have sufficient cash or credit to insulate their families from the effects of low prices.

conceptually at least, and different groups take their stands on the basis of estimates or assumptions as to how their economic positions will be affected by alternative programs.

2. Alternative farm price support programs may be described in terms of (a) commodity coverage, (b) level of support, (c) method of support, and (d) restrictions as to the quantities of products that are eligible for support. From these descriptions, their effects on farm prices, production and income can be estimated, under specified assumptions as to the levels of domestic and foreign demand. When administrative discretion is allowed on any of the four points mentioned, it is necessary to make additional assumptions as to how this discretion will be used in order to arrive at numerical answers.

3. Direct financial benefits to farmers can be assessed tolerably well from information described in the preceding paragraph. The costs and benefits of the programs to nonfarmers, however, depend on the methods by which the government costs are financed. If compensatory payments are financed out of taxes on current (chiefly nonfarm) incomes, taxpayers as a group are worse off by approximately the amount of the government payments to farmers. The position of individual taxpayers will depend upon the progressive or regressive character of changes in the tax rate structure made in response to changes in farm price support costs.

If compensatory payments are deficit financed, the *current* position of nonfarm consumer-taxpayer units (short of full employment) is improved to an extent depending on the general multiplier. The *ultimate* effect on the financial position of consumer-taxpayer units (assuming that government costs are ultimately paid out of taxes) will depend on the tax structure.

4. As compared to free market conditions, a purchase and diversion program on perishable commodities involves two type of costs. *The cost to Government* of acquiring, processing, storing, and transporting surplus quantities of such commodities, less recoveries on sales, represents for the most part a transfer of income, either currently or ultimately, from taxpayers to farmers. *The cost to consumers* due to higher-than-free-market prices represents, for the most part, a transfer of current income from consumers to farmers.[4]

[4] There are certain difficulties in assessing the dollar-and-cents cost of price supports to consumers. A slightly low approximation may be obtained by multiplying the difference between retail prices with and without the support program by the quantity taken by the consumers at the supported price.

The incomes of various marketing agencies may also be affected by diversion programs. A very detailed empirical study would be required to work out the effects of such programs upon each type of marketing agency. In general, it appears that the aggregate income of marketing agencies will be affected by a much smaller absolute amount than will income to farmers.

5. Loan programs for storable crops are more difficult to evaluate. In any one year, net additions to government stocks of these commodities would have about the same effects as would purchases of perishable commodities. However, subsequent changes, planned or unplanned, in supply and demand conditions might permit net reductions in government stocks (hence, net benefits to taxpayers). To the extent that release of such stocks makes market prices lower than they would otherwise have been, there are also net benefits to consumers. In effect, this means that taxpayers sell to consumers at less than "free market" prices. If the taxpayer is bailed out by production controls which raise the average price to consumers over a period of years above the "free market" level, the program does involve an income transfer from consumers to farmers.

Mathematical Exposition

For the sake of precision, the calculations required for the measurement of costs and benefits are described in terms of equations. These equations are little more than check lists of the economic magnitudes involved in each step of the analysis. Those who are bored by symbols can follow the presentation readily by reading the side headings and the intervening text. The mathematical exposition is followed by a short, nontechnical section containing summary comments and conclusions.

Benefits to farmers.—The basic income guaranteed to farmers by a price support program may be written as

$$(1) \qquad G_f = \sum_{i=1}^{m \leq n} (q_i r_i)(p_i{}^0 \rho_i),$$

where m represents the number of supported commodities, n the total number of farm commodities, q_i the total marketings of a given commodity, and r_i the percentage of those marketings eligible for support, $p_i{}^0$ the parity price or price support standard, and ρ_i the percentage of this standard at which farm returns are to be supported.

In the absence of a price support program, cash receipts to farmers would be

$$(2) \qquad CR_f = \sum_{i=1}^{n} q_i p_i,$$

where n represents the total number of farm commodities and q_i and p_i represent the volume of marketings and the price of an individual commodity.

If there is a price support program, cash receipts may be written as

$$(3) \quad CR_s = \sum_{i=1}^{n-m+r} q_i p_i + \sum_{i=1}^{l} q_i(\rho_i p_i{}^0) + \sum_{i=1}^{k} [(q_i r_i)(\rho_i p_i{}^0) + q_i(1 - r_i)p_i],$$

where n–m commodities are not eligible for support and market prices of r additional commodities are above support levels; l commodities are supported by purchase and diversion or storage methods, and k commodities are supported by means of compensatory payments. It is assumed that all producers will get the full support price under a purchase program, since the operations undertaken to protect cooperators hold an umbrella over noncooperators. On the other hand, it is assumed that compensatory payments are made only on the quantities eligible for support, while the remaining quantities bring the free market price.

The cash benefits to farmers of a price support program (as compared with no program) are equal to Equation (3) minus Equation (2):

$$B_f = CR_s - CR_f. \tag{4}$$

Costs to Government.—The cost to Government of a compensatory payment program (as compared with no program) is

$$L_c = \sum_{i=1}^{k} (q_i r_i)[\rho_i p_i^0 - p_i], \tag{5}$$

where the expression in brackets represents the difference between the free market price and the support level.[5]

---

[5] In an earlier draft, the expression

$$A_i + B_i q_i + C_i Y + D_i E = p_i \tag{5.1}$$

was substituted for p_i. This expresses the dependence of the market price (p_i) upon total marketings (q_i), domestic demand (Y), and export demand (E). In technical language, this is a "reduced form" equation reflecting the combined effects of separate domestic and foreign demand curves. Let the domestic demand curve be

$$p_d = a + bq_d + cY \tag{5.2}$$

and the export demand curve

$$p_e = \alpha + \beta q_e + \gamma E \tag{5.3}$$

where Y is domestic income, E is a measure of foreign demand, and q_d (domestic marketings) plus q_e (exports) equals q_i (total marketings).

In equilibrium the prices of domestic and export quantities are equal, so $p_d = p_e = p_i$. By algebraic manipulation we obtain

$$p_i = \left[\frac{\alpha b + a\beta}{b + \beta}\right] + \left(\frac{b\beta}{b + \beta}\right) q_i + \left(\frac{c\beta}{b + \beta}\right) Y + \left(\frac{b\gamma}{b + \beta}\right) E \tag{5.4}$$

or, in abbreviated notation,

$$p_i = A_i + B_i q_i + C_i Y + D_i E. \tag{5.1}$$

However, this is one of a large number of possible demand structures for different farm products. This particular model might apply roughly to wheat, cotton, and tobacco, which make up about two thirds of our agricultural exports and which require a substantial proportion of the total use of CCC loan funds. Even for these commodities the structures should be extended to include private storage demand, demand for wheat as a feed, and perhaps a supply function for imports of each commodity.

The cost to Government of a purchase and diversion or storage program is

$$L_p = \sum_{i=1}^{1} R_i(\rho_i p_i^0)\left[\frac{1}{B_i}(\rho_i p_i^0 - p_i)\right], \quad \text{or} \tag{6}$$

$$L_p = \sum_{i=1}^{1} R_i(\rho_i p_i^0)\Delta q_i, \tag{6.1}$$

where R_i represents the ratio of final net losses to the initial farm value of the commodities purchased, and

$$\left[\frac{1}{B_i}(\rho_i p_i^0 - p_i)\right] = \Delta q_i$$

represents the quantity which must be purchased by the Government in order to maintain the support price. B_i is the net regression of price upon total marketings in a composite demand equation such as (5.1) in footnote 5.

Effects on consumers.—The adverse current effects of a purchase and diversion program on consumers (compared with no program) may be written as

$$S_p \geqq \sum_{i=1}^{1} (q_i - \Delta q_i)b_i\Delta p_i, \tag{7}$$

where Δq_i is the amount purchased to maintain farm prices at the support level, Δp_i is the difference between the "free market" price and the support price, and $b_i \geqq 1$ is the ratio of the increase in the retail price of commodity i to the increase in farm price resulting from the purchase program. If $b_i \geqq 1.1$ and if $\Delta q_i \leqq 0.1\ q_i$, we may write Equation (7) as

$$S_p \geqq \sum_{i=1}^{1} q_i(\rho_i p_i^0 - p_i). \tag{7.1}$$

In the case of individual feed grains, oilseeds, and members of the meat and poultry group, Equation (5.1) must be broadened to allow for the effects of competing commodities. But a large number of farm products seem to have no competitors of measurable importance (on the demand side) on a year-to-year basis. For examples of estimating equations which might be used in analyzing price support costs, see the author's paper on "Factors Affecting Farm Income, Farm Prices and Food Consumption," *Agricultural Economics Research*, July 1951, pp. 65-82.

In Equation (5.1), total marketings (q_i) may be largely influenced by weather, an exogenous or noneconomic variable. Consumer income (Y) and the general level of export demand (E) are largely but not wholly independent of price support programs. These variables indicate the difficulty of predicting the costs of price support in some actual future year. However, a good deal can be learned by *assuming* different values of these variables and estimating the prices (and price support costs) which would be associated with them on the basis of past relationships. The Bureau of Agricultural Economics has had considerable experience with projections of this sort, and on the basis of it the author would place a much higher value on conditional forecasts or projections than does Dr. Mehren (op. cit., pp. 742-43).

The right-hand term is equal to the benefits to farmers arising from a purchase and diversion program currently financed.

Compensatory payments do not change the position of consumers as such compared with their position under no program.

Effects on taxpayers.—The adverse effects on taxpayers of a purchase and diversion program currently financed (compared with no program) are simply the costs to Government, L_p. Similarly, the adverse effects on taxpayers of compensatory payments currently financed are the costs to Government, L_c.

The adverse effects on consumers and taxpayers combined would be

$$(8.1) \qquad S_p + L_p \geqq \sum_{i=1}^{1} q_i(\rho_i p_i^0 - p_i) + L_p$$

in the case of purchase programs currently financed, and simply L_c in the case of compensatory payments. Benefits to farmers (Equation 4) under currently financed programs may be elaborated as follows:

$$(4.1) \qquad B_f = CR_s - CR_f = L_c + \sum_{i=1}^{1} q_i(\rho_i p_i^0 - p_i), \text{ where } L_c$$

is the increased income due to compensatory payments and the other term represents increased income arising from purchase programs.

Ratio of benefits received by farmers to costs sustained by consumers and taxpayers.—Equations (8.1) and (4.1) may be used to compute ratios of benefits received by farmers to costs incurred by consumers and taxpayers combined under currently financed programs, as follows:

The ratio of total costs to benefits under a purchase program is

$$(9.1) \qquad \frac{S_p + L_p}{B_f(p)} \geqq \frac{\sum_{i=1}^{1} q_i(\rho_i p_i^0 - p_i) + L_p}{\sum_{i=1}^{1} q_i(\rho_i p_i^0 - p_i)}.$$

Substituting from Equation (6.1) we obtain

$$\frac{S_p + L_p}{B_f(p)} \geqq 1 + \frac{\sum_{i=1} R_i(\rho_i p_i^0) \cdot \Delta q_i}{\sum_{i=1}^{1} q_i(\Delta p_i)}$$

where Δq_i is the amount purchased to attain the support price and Δp_i is the difference between the support price and the "free market" level. If there is no correlation between the various elements in the right hand term, we may write

$$\frac{S_p + L_p}{B_f(p)} \geqq 1 + \bar{R}\bar{\eta} \tag{9.2}$$

where R is the average ratio of final net losses to the initial farm values of commodities purchased, and $\bar{\eta}$ (taken as positive in sign) is the average elasticity of demand for commodities involved in the purchase program. (Note that η_i is approximately equal to

$$\frac{\Delta q_i}{\Delta p_i} \cdot \frac{p_i p_i^0}{q_i}$$

in the range between "free market" and support prices, if the difference between the two prices is not very large.)

The ratio of total costs to benefits under a production payments program is

$$\frac{L_c}{B_f(c)} = 1. \tag{9.3}$$

Thus, *in terms of total cost to consumers and taxpayers,* compensatory payments are more efficient than purchase programs in conveying dollar benefits to farmers so long as $\bar{R}$ is positive; i.e., so long as final losses are realized on the purchase and diversion operations. Leaving aside administrative costs, at least $(1 + \bar{R} \cdot \bar{\eta})$ dollars would be required to convey a dollar of benefits to farmers through a purchase program, compared with only one dollar under compensatory payments.

A diversion program on perishable products involves higher prices to consumers at the time of purchase, and almost invariably results in some costs to taxpayers. However, a perfectly self-liquidating storage program would involve no net loss to taxpayers, so the term $\bar{R} \cdot \bar{\eta}$ would be zero. If, in addition, the storage stocks were resold to the same consumers from whom they were originally withheld, the effect of the program would be to shift the time-distribution of farm income without altering its average level. Consumers would absorb the cost of storage, presumably in return for the Government's service in altering the time-distribution of their purchases.[6]

Since η for most farm commodities is less than 1, and since R is seldom more than 1, the total cost of purchase programs to consumers plus taxpayers will rarely if ever be as much as twice that of compensatory payments for a given level of farm benefits.

It should be noted, however, that *the relative costs to taxpayers alone*

[6] There is even the possibility that taxpayers might profit on storable commodities at the expense of consumers.

will be $\overline{R} \cdot \overline{\eta}$ per dollar benefit to farmers under a purchase program, as compared with dollar for dollar under compensatory payments. This means that if the demand for a commodity is highly inelastic, and/or the loss ratio R is considerably less than 1, the cost to Government of a purchase and diversion or storage program may be a great deal less than that of compensatory payments.

Effects of deficit financing.—So far we have assumed that benefits to farmers have been met by current transfers from consumers, taxpayers, or both. The effects of deficit financing of (1) compensatory payments and (2) government purchases upon national income (Y), nonfarm income (Y_n) and farm income ($Y_f = CR_f$) may be written as follows:

For compensatory payments we have

$$\Delta Y = m \cdot L_c \tag{10.1}$$

$$\Delta Y_n = (m - 1)L_c - 0.1\Delta Y \tag{10.2}$$

$$\Delta Y_f = L_c + 0.1\Delta Y \tag{10.3}$$

where m is the "multiplier," L_c is the amount of compensatory payments, and $0.1\ \Delta Y$ is the approximate effect of the increase in national income upon farm cash receipts, based on statistical relationships during the 1924-41 period.[7]

For government purchases we obtain the same set of equations except that L_p is substituted for L_c, where L_p is the net cost to Government of purchasing, handling and disposing of commodity surpluses. We have previously written

$$L_p = \sum_{i=1}^{1} R_i(\rho_i p_i^0)\Delta q_i \tag{6.1}$$

where R_i has been regarded as the ratio of ultimate realized losses to the initial farm value of the purchased commodity i. For short run analysis, however, L_p will have to be regarded as the net excess of government outlays (including loans) over government receipts (including loan repayments) during the period under consideration.

If the multiplier is 2 and either L_c or L_p is a billion dollars, we have

$$\Delta Y = 2 \text{ billion}$$

$$\Delta Y_n = (2 - 1)(1) - 0.1(2) = 0.8 \text{ billion}$$

$$\Delta Y_f = 1 + 0.1(2) = 1.2 \text{ billion.}$$

[7] The appropriate value of the "multiplier" at any given time is presumed to be based on empirical studies. See A. R. Smithies, "The Multiplier," *American Economic Review*, Proceedings Number, May 1948, pp. 299-305.

If m were as high as 2.5, we should have

$$\Delta Y = 2.5 \text{ billion}$$

$$\Delta Y_n = (2.5 - 1)(1) - 0.1(2.5) = 1.25 \text{ billion}$$

$$\Delta Y_f = 1 + 0.1(2.5) = 1.25 \text{ billion.}$$

Different assumptions as to the general multiplier lead to greater differences in estimating the effects of farm programs on nonfarm than on farm income.

Perhaps one other aggregative equation is in order, to show the net effects on consumers of a purchase program with L_p deficit financed, but taking account of the resulting higher prices to consumers:

(11.1) Net Effect $= \Delta Y_n - S_p$. From equations (10.1) and (10.2) we have $\Delta Y_n = (0.9\,m - 1)L_p$; and from equations (7.1) and (9.2)

$$S_p \geqq \left(\frac{1}{\bar{R} \cdot \bar{\eta}}\right) L_p.$$

Hence,

(11.2) $$\text{Net Effect} \leqq \left(0.9\,m - 1 - \frac{1}{\bar{R} \cdot \bar{\eta}}\right) L_p.$$

If the multiplier $m = 2$, we have

(11.3) $$\text{Net Effect} \leqq \left(0.8 - \frac{1}{\bar{R} \cdot \bar{\eta}}\right) L_p.$$

Equation (11.3) implies that, with a multiplier of 2, the adverse effects of higher prices to consumers will more than offset the favorable "multiplier" effects of deficit financing upon nonfarm income unless $\bar{R} \cdot \bar{\eta} > 1.25$. If $\bar{R} \cdot \bar{\eta} = 1.25$ and L_p is a billion dollars, nonfarm money income will be about 0.8 billion dollars higher than with no program, but additional costs to consumers will be at least 0.8 billion dollars. For most farm commodities, the elasticity of demand (η) is less than 1, and the ratio of net loss to purchase cost (R) is less than 1.25. Hence, the multiplier effect of deficit financing will probably not offset the adverse effects of higher consumer prices under a purchase program covering a number of commodities, unless the multiplier is much higher than the values of 2 to 3 generally attributed to it. An inelastic demand and a favorable net loss ratio on diversion both increase the leverage of government costs, L_p, upon consumer prices.

Effects on consumer-taxpayer units at different income levels.—So far we have dealt only with aggregate costs to all consumers or all taxpayers. But the incidence of these costs will vary according to the level of family

income and the levels of food expenditure and taxation associated with it. It is possible to express the net effects of alternative programs upon individual consumer-taxpayer units classified according to income, as follows:

For each consumer-taxpayer unit j, we define three "shares" or proportions. These are

$$c_j = \frac{\text{Expenditures of family j on farm products (dollars)}}{\text{Total U.S. expenditures on farm products (billion dollars)}}$$

$$t_j = \frac{\text{Federal taxes paid by family j (dollars)}}{\text{Total federal taxes (billion dollars)}}$$

$$n_j = \frac{\text{Income of family j (dollars)}}{\text{Total U.S. income (billion dollars)}}$$

The first of these, c_j, may be measured in terms of equivalent retail store prices. The second, t_j, may be measured in terms of federal income taxes exclusively, *if* we wish to assume that program costs are covered by specific increases in such taxes. The third, n_j, may be measured in terms of income before taxes if our multiplier, m, is also defined in terms of relative changes in incomes before taxes.

The net effects of any combination of support methods and methods of financing upon a typical consumer-taxpayer unit at any given level of family income can be described in terms of the above three measures. These effects may be tabulated as follows;

TABLE I. NET EFFECT OF ALTERNATIVE PROGRAMS ON CONSUMER-TAXPAYER UNIT j

Type of financing	Type of price support	
	Compensatory payments	Purchase programs
	(1)	(2)
(1) Current increase in income taxes	$-t_j \cdot L_c$	$\left[-t_j - \frac{\bar{b}}{\bar{R} \cdot \bar{\eta}} c_j\right] \cdot L_p$
(2) Deficit financing	$\left[(0.9m-1)n_j\right] \cdot L_c$	$\left[(0.9m-1)n_j - \frac{\bar{b}}{\bar{R} \cdot \bar{\eta}} c_j\right] \cdot L_p$

Deficit financing of either program improves the current income position of the unit relative to its situation with financing out of current taxes. But for any given level of total price support costs, the consumer-tax-

payer will be worse off under a purchase program than under compensatory payments by the amount

$$\frac{\bar{b}}{\bar{R} \cdot \bar{\eta}} \cdot c_j \cdot L_p$$

In this expression, $\bar{b}$ is the average ratio of changes in retail prices of farm products to changes in farm prices (in effect, a "percentage mark-up" factor); $\bar{R}$ is the average ratio of realized losses to initial farm values of purchased commodities; and $\bar{\eta}$ is the average elasticity of demand for such commodities measured at the farm price support level.[8] This expression could be interpreted as implying that a given expenditure by Government would result in maximum injury to the consumer interest if diversion

---

[8] The derivation of the expression $\left(\frac{\bar{b}}{\bar{R} \cdot \eta}\right)$ requires some explanation. Let q_i represent the free market consumption of commodity i by a consumer-taxpayer unit j; p_i and P_i the farm and retail prices respectively with no program, where $P_i = a + bp_i$. Then consumption at the supported farm price ($\rho_i P_i = P_i + \Delta P_i$) is $q_i - \Delta q_i$, and the new retail price is $P_i + b \Delta p_i$. A minimum estimate of the effect of price supports on unit j as a consumer is

$$\sum_{i=1}^{1} (q_i - \Delta q_i) b \Delta p_i$$

for all supported commodities purchased by him.

The program costs to Government may be written as

$$L_p = \sum_{i=1}^{1} R_i(\rho_i p_i^0) \Delta q_i, \text{ from Equation (6.1).} \tag{12.1}$$

But for any commodity i the elasticity of demand at the point ($\rho\ p_i^0$, $q_i - \Delta q_i$) may be written:

$$\eta_i = \frac{\Delta q_i(\rho_i p_i^0)}{\Delta p_i(q_i - \Delta q_i)} = \frac{l_{pi} \cdot b_i}{R_i \cdot s_{pi}} \tag{12.2}$$

where $s_{pi} = (q_i - \Delta q_i)\ b\Delta p_i$ represents the minimum adverse effect on the consumer.

Then from Equation (12.2) we have

$$s_{pi} = \frac{b_i}{R_i \eta_i} \cdot l_{pi}, \tag{12.3}$$

where for consumer j and commodity i, l_{pi} represents the government cost of the particular quantity Δq_i of which j is deprived by the support program.

If the loss ratios, markup factors, elasticities, prices and quantities of different commodities are not substantially correlated, Equation (12.3) may be generalized for all commodities used by unit j:

$$\text{Net Effect}_j \text{ (consumer)} = s_{pj} = \frac{\bar{b}}{\bar{R} \cdot \bar{\eta}} \cdot c_j \cdot L_p. \tag{12.4}$$

activities were concentrated on products with inelastic demands, good diversion outlets, and high percentage markups.

Summary and Conclusions

The foregoing presentation may seem quite abstract, since it is the framework for an analysis rather than the analysis itself. But the specific data for actual price support programs can be substituted into it readily. The required calculations are simple, though extensive, as suggested by Dr. Mehren's analysis for the year 1949. However, the aura of uncertainty which has surrounded the question of price support costs can be partially dispelled without carrying out a full set of calculations.

From a practical standpoint, costs to Government are scrutinized much more closely than are costs to consumers. So far, the concept of "social cost" (to taxpayers and consumers combined) has won little political acceptance.

The effects of raising the level and extending the coverage of price supports are obviously to increase costs to Government (or at least the contingent liability of Government). The change in costs resulting from a change in the method of support is less obvious. The cost to Government of a purchase program is

$$L_p = \sum_{i=1}^{i} R_i(\rho_i p_i^0)\Delta q_i, \tag{6.1}$$

and that of a compensatory payment program for the same commodities is

$$L_c = \sum_{i=1}^{i} (q_i r_i) \cdot \Delta p_i. \tag{5}$$

Dividing (6.1) by (5) we obtain

$$\frac{L_p}{L_c} \cong \frac{\bar{R} \cdot \bar{\eta}}{\bar{r}}, \tag{13}$$

where, as before, $\bar{R}$ is the average ratio of final net losses to the initial purchase cost (or loan value), $\bar{\eta}$ is the average elasticity of demand for these commodities in all commercial uses, and $\bar{r}$ is the average percentage of production which is eligible for compensatory payments.

The recovery ratio, $1\text{-}\bar{R}$, is almost always overlooked by "root-and-branch" critics of price supports. It was frequently alleged that stocks of wheat, corn, and cotton acquired from the 1948 and 1949 crops would be a total loss to both taxpayers and consumers. As a matter of fact, a large share of these stocks had already been worked off by the summer of 1951 —all, in the case of cotton. In terms of Equation (13), $\bar{R}$ may well be close to zero on storables in the future as in the past.

Domestic demand elasticities for most of our storable crops are considerably less than one. This fact enhances the advantage of loan and storage methods over compensatory payments in terms of costs to Government. Also, it is difficult to see how strategic reserves could be maintained under a compensatory payment program as ordinarily conceived.

In the case of perishable commodities the loss ratio, R, may sometimes be equal to or greater than one. Nevertheless, demand for some perishables is so inelastic that purchase and diversion methods will still involve less cost to Government, once a given supply has been produced. Where $\bar{\eta}$ and $\bar{R}$ are both close to one, compensatory payments will involve about the same cost to Government as will purchase and diversion, and may be more desirable on other grounds.

The term $\bar{r}$ (the proportion of total marketings eligible for support) reflects the generally greater feasibility of discriminating in favor of "cooperators" under a compensatory payment than under a purchase program.[9] If $\bar{r}$ proves to be very small, it may shift the cost advantage (to Government) in favor of compensatory payments for some commodities with relatively inelastic demands. But total cash benefits to farmers will be reduced in the same proportion.

Benefits to farmers may be compared with costs to Government under the two methods as follows:

$$B_{f(p)} = \sum_{i=1}^{1} q_i \Delta p_i \tag{4.1}$$

$$L_p = \sum_{i=1}^{1} R_i(\rho_i p_i^0) \cdot \Delta q_i; \quad \text{hence} \tag{6.1}$$

$$\frac{B_{f(p)}}{L_p} \cong \frac{1}{\bar{R} \cdot \bar{\eta}} . \tag{14}$$

If demand is very inelastic, a small outlay for government purchases will have a much larger effect on farm income. In contrast, cash benefits to farmers in the form of compensatory payments will be the same as costs to Government, excluding administrative expenses.

The ultimate incidence of price support costs upon taxpayers is difficult to foresee. It is hardly likely that federal income taxes will be raised or lowered specifically to cover changes in the cost of price support. As a matter of practice, CCC loans can expand and contract over a wide range without involving current levies on, or refunds to, taxpayers. The effects on consumers are more readily demonstrated.

[9] However, marketing quotas backed by penalties for overplanting offer an effective means of discrimination under loan and storage programs for some cash crops.

No allowance was made in the algebraic development for the effect of price support programs on production. It has been argued, for example, that use of compensatory payments would lead to more effective marketing controls, raising market prices and reducing the unit payments required to compensate those cooperating with the program. The real effects would undoubtedly vary between commodities. The sharp reduction in cotton acreage from 1949 to 1950 indicates that substantial compliance can also be obtained under a loan and storage program where conditions are favorable.

Perhaps one other point should be mentioned in closing. There is an approximate equality between cash benefits to farmers and cash costs to consumers under a purchase program. There is also an approximate equality between benefits to farmers and costs to Government under a compensatory payment program. A support program involving large cash benefits to farmers will involve large costs to consumers or Government; conversely, a low cost program will provide small cash benefits. Our loan programs on storable commodities have been low cost programs in the sense used here. But this is by no means to deprecate their importance. They have provided large benefits to farmers when most needed, and large benefits to consumers and to the national defense at times when farmers were relatively well off.

A PRODUCTION FUNCTION AND MARGINAL RATES OF SUBSTITUTION IN THE UTILIZATION OF FEED RESOURCES BY DAIRY COWS*

EARL O. HEADY
Iowa State College

A WAVE of physical experiments is now under way over the Nation in an attempt to find means of utilizing additional quantities of forage crops. This interest stems from several sources. One is the general public interest in conservation (with more grasses and legumes as one means to this end) and the specific interest of grassland-farming devotees in attaining a goal of all or a major portion of the land area planted to forage crops.[1] Interest is high in the Southeast in the hope that improved varieties and increased production and use of forages will provide the foundation for a prosperous livestock economy for the area. The possibility of war-geared production also gives rise to interest in the degree of substitution and optimum allocation of specific resources. Regardless of the source of momentum, the increased number of investigations of this nature is to be commended. As any production economist is aware, it is the quantitative relationships (physical and value) for the several categories of resources and products which determine their optimum (individual and social) use and combination.[2]

Two important aspects of the feed utilization problem are (1) the marginal rates of substitution of specific feeds and (2) the risk or uncertainty which attends livestock production under different feeding methods. The analysis of this study is of both *methodological* interest and *practical* application.[3] We not only present the basic hypotheses (models) but also provide detailed steps in empirical estimates and data for livestock feed combination.

No Cause to Extend

This study is exploratory, and indeed does not attempt to answer all of the problems in feed utilization economics. The estimates relate mainly

* Journal paper J-2036 of The Iowa Agricultural Experiment Station, Ames, Iowa, Project No. 1135.

[1] For application of this problem to control programs see Heady, "Resource and Revenue Relationships in Agricultural Control Program," *Review of Economics and Statistics*, Aug. 1951.

[2] Additional details on substitution relationships can be obtained from Heady and Olson, "Marginal Rates of Substitution and Uncertainty in the Utilization of Feed Resources with Special Emphasis on Forage Crops," *Iowa Journal of Science*. Iowa State College, Nov. 1951. Agr. Exp. Sta. Journal paper no. J-1867.

[3] For application of data of this nature see Heady and Jensen, *Economics of Crop Rotations*, Iowa Agr. Exp. Sta. Bul. 383; Heady and Scoville, *Principles of Conservation*, Iowa Agr. Exp. Sta. Bul. 382; Heady and Allen, *Returns from Capital in Conservation Investments*, Iowa Agr. Exp. Sta. Bul. 381.

to methodological problems. A very great amount of additional research in animal nutrition is necessary as a basis for refined studies of the nature outlined here. Certainly the physiological and related aspects are important in feed substitution. This study deals only with economic implications of the physical relationships and is a report of preliminary work dealing with feed utilization. This particular summary is made largely to interest and inspire other physical and economic scientists in the problems and methodological procedures employed. We have no "cause" to extend in the analysis presented. We do not claim that the data provide the rate of substitution for all possible types of feed and all capacities of cows. We are not trying to substantiate any preconceived and unshakable belief of our own, but only to test some hypotheses in the manner of science. We simply present the results of an empirical procedure applied to one set of data and review the basic logic which relates to it. Perhaps substitution rates are even linear within ranges for some livestock.

Fundamental Structural Relationships

We have previously outlined in detail that when two enterprises as forage and grain serve on the one hand as primary products, and on the other hand as resources inputs for a secondary product such as livestock, output of the latter can be maximized when (a) the marginal rate of substitution of crops as product outputs in the rotation is equal to (b) the marginal rate of substitution of the same crops as feed inputs for livestock production.[4] Too, it is accepted economic doctrine that the cost of a given product (e.g., 100 pounds of milk) can be minimized when the price ratio of competitive resources (such as grain and forage) is equal to the substitution ratio of the resources. The determination of these "maximum" positions requires that quantitative physical data be available for estimating both the iso-resource curve for crops in rotation and the iso-product curve for crops as feed inputs. Important especially is information on the marginal rates of substitution of grain and forage crops.

Empirical Estimates

On the pages which follow we explain empirical estimates which are derived for certain livestock feed relationships. These are confined to dairy cows and are based on the original data for the Jensen input-output study.[5] It should be emphasized that the following empirical estimates

[4] See Heady, "Economics of Rotation," *this Journal*, May, 1948, for further details on these relationships.

[5] Einar Jensen and others, *Input-Output Relations in Milk Production*. U.S.D.A. Tech. Bul. 815. Washington, D.C. June 1942.

appear to be about the best which can be derived from available experimental data for dairy cows. After making a rather wide survey of the physical input-output data available, we decided that the study cited provides information which best lends itself to the grain-forage substitution relationship. The Jensen study was directly related to levels of grain feeding for dairy cows and only indirectly to substitution rates. However, since higher levels of grain feeding were possible only as levels of hay feeding were reduced, the resulting data included an element of feed substitution as well as a pure grain-milk input-output relationship.[6]

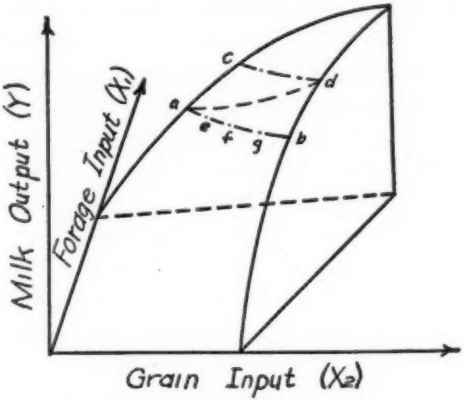

FIG. 1. PRODUCTION SURFACE AND ALTERNATIVE ESTIMATIONAL OUTCOMES

The possible limitations of the Jensen data in predicting substitution relationships (as well as direct input-output relationships) can be illustrated by reference to the hypothetical example in Figure 1. Here the process of milk production is represented as a production surface. The vertical or Y axis is taken to represent milk output per cow, while the "left hand" or X_1 axis represents the amount of forage fed. Thus milk output might be held at some fixed level such as that indicated by the contour *ab*. This same level of milk production (say 8,000 pounds per cow) might be attained by feeding more hay and less grain (movement from the right to the left on contour *ab*), or more grain and less hay (movement from the left to the right on *ab*). An experiment in dairy production designed to isolate substitution rates *per se* would attempt to hold milk

[6] Economists will recognize that we are attempting to derive the factor-factor relationship in production, while the Jensen experiment was designed more nearly to isolate the factor-product relationship. The study did, however, interrelate the factor-factor and the factor-product relationships in the manner to be outlined.

output per cow constant (at *ab* for example) and simply "move around" *ab*. An experiment designed to get at the grain-input and milk-output relationship alone would hold hay per cow at some fixed level (as that indicated at *a* or *b*) and "move up" *ac* or *bd*. An experiment could also be designed (but would extremely difficult and costly) which would attempt to estimate that portion of the production surface indicated as *abdc* in Figure 1. This would be accomplished by holding milk per cow constant at several levels (such as *ab* or *cd*) and varying the quantity of grain and hay for each of these levels.

The Jensen study (including all cows) was not primarily designed to isolate any of the above relationships. Rather, it more nearly traced out a line such as *ad* in Figure 1. This line partly confounds the grain-forage substitution relationship with the grain-input milk-output relationship. Starting from the standard Haecker ration(which might be indicated as point *a* in Figure 1), cows were fed greater amounts of grain and were allowed to make their own selection of forage intake. Two things happened as higher levels of grain were fed: (1) Less hay was consumed per cow, and (2) more milk was produced from each cow.

The sample of cows which we selected from the several hundred in the Jensen study appeared to give a fair scatter over an entire "slice" (such as *abdc*) of the production surface. However, we cannot be certain that confounding of the two relationships (factor-factor) and (factor-product) has been entirely eliminated.[7] The production function (the production surface or a portion of it such as *abdc* in Figure 1) and the product contour or substitution line (the forage grain line such as *ab*) have been derived for milk production in the manner to be outlined.

Detail on derivation of substitution rates is given below. Again, it is our hope that these data (1) may be of some practical use (given the current paucity of experimental data from which substitution rates can be derived), and (2) can serve to generate additional effort in design of experiments and empirical techniques which will allow estimate of substitution rates. With the great emphasis now being placed on grassland farming, the problem is of important magnitude.

The Physical Production Process

The production function (relationship between input and product output) for livestock is of the general form $Y = f(X_1, X_2, X_3, X_4, X_5, X_6, \ldots X_n)$ where Y represents the output of product, while the inputs are forage,

[7] Actually the "summit" of the production surface in milk production may more nearly take the form of *ad* in Figure 1. Because of the limited capacity of a cow's stomach, maximum milk output per cow must necessarily vary with the proportions of different feeds in the ration.

grain, protein supplements, labor, other capital, time and other specific resources.[8] Cattle fed on grass (more forage) may require less of both labor and grain than cattle fed in dry-lot (less forage). Grain is not only a substitute for forage in producing meat, but also is generally a substitute for time. (A shorter time span is required for an animal fed a "high-grain" ration than for one fed a "high-forage" ration in attaining a given output of product of specified grade). Thus, final solution of the forage utilization problem depends on establishing the nature and rate of substitution of various forages for time, labor, and other capital resources in addition to grain.

The Dairy Production Function

Our first derivations are for the dairy production function. The full procedure involves three steps (1) the production function, (2) the isoproduct equation (the combination of grain and forage to produce a given quantity of milk product) and (3) the marginal rate of substitution of hay for grain (the amount of grain replaced by each successive pound of hay with output constant). The estimates are based on observations for 34 individual cows over a year's time from the Jensen experiment. We have employed only Series II data (grain ration varied with free choice of hay) for all heavy-breed cows (Holstein and Brown Swiss), receiving comparable feeds (hay, corn silage, and grain) all with an expected output-capacity of 300 to 400 pounds (when fed the standard Haecker ration). Pasture was converted to a hay-equivalent and silage was broken down into a grain and a forage component.[9] Because of the complexity of the analysis and the paucity of data only feed inputs have been included in estimates of the production function.[10] We thus make estimates of the forage-grain product contour (curve *ab* or *cd* in Figure 1) from a production function

---

[8] These are broad categories or aggregates of resources and might (should) be further classified. For example X_1 (forage) might be further subdivided into x_1 (alfalfa), x_2 (no. 1 grade clover), x_3 (bluegrass pasture), x_4 (no. 4 grade clover), x_5 (brome grass silage).

[9] While not strictly correct, since it assumes a constant rate of substitution between hay and forage from silage and between straight grain and grain from silage, components of silage were converted in terms of their energy replacement value on the basis of Morrison standards (Morrison, *Feeds and Feeding*. Eighth Edition. Morrison Publishing Company, Ithaca, New York).

[10] While this restricted analysis allows consideration of the economy of two specific feeds, it does not allow efficiency measurements when other resources are not scarce. The simple production function is alone relevant only when all other resources are fixed or free in the sense that costs are not attached. We have derived production functions including time as one variable in livestock production as related to different rations. Though they are extremely important, presentation of these data is precluded by space limits.

which now takes the form $Y = f(X_1, X_2)$. (Y refers to milk output while X_1 refers to forage input and X_2 refers to grain input per cow.)

In our initial work we employed six related but distinct production functions (regression equations):

(1) $Y = \alpha X_1^{\beta_1} X_2^{\beta_2}$

(2) $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1^2 + \beta_4 X_2^2 + \beta_5 X_1 X_2$

(3) $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1^2 + \beta_4 X_1 X_2$

(4) $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1^2 + \beta_4 X_2^2$

(5) $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_1^2$

(6) $Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_2^2$

(7) $Y = \alpha + \beta_1 X_1 + \beta_2 X_2.$

The first two production functions seemed a logical hypothesis, since they allow a diminishing rate of transformation of each feed and the productivity of one feed depends upon the level at which the other is fed. The first assumes constant elasticity of production but possible diminishing marginal productivity: a one percent increase in amount of one feed, the other constant, will result in the same percentage increase in output over all inputs. Equation (2) allows for a declining elasticity of production as well as diminishing returns for each or both feeds. The same possibilities existed in the third production function. The fourth allows diminishing transformations of each feed but no joint action. The fifth and sixth each allow diminishing returns to one feed, with a condition of linearity for the other. The seventh equation tests the hypothesis of a completely linear production function. In equations four through seven inclusive, the productivity of one feed does not depend on the amount of the other one which is fed.

The second (2) production function is statistically acceptable over the other equations with squared or linear terms, but is hardly acceptable in the logic of production. The coefficient β_5 was significant at the five percent level of probability, while coefficients for the other variables were significant at the one percent level.[11] With Y as milk and X_1 and X_2 as forage and grain, respectively (with all variables measured in 100 pounds), the following coefficients were derived for the production functions:

(2) $Y = 352.0 - 4.8434X_1 - 5.4937X_2 + .019015X_1^2 + .022887X_2^2 + .057101X_1X_2$

[11] The t values for the β's of production function 1 are (a) 2.11, (b) 2.34, (c) 1.97, (d) 2.28 and (e) 3.07 (in order of their sequence in the regression equation).

Since the regression coefficients for the X_1^2 and X_2^2 terms are positive while those for the linear terms are negative, the equation gives increasing returns in part of the range of observations. Accordingly, the production function may be rejected in terms of production logic and previous findings of diminishing returns. The regression coefficients for the first production function are acceptable at the five percent level of probability.[12] The derived function is given below with feed measured in pounds:

$$(1)\quad Y = 3.56X_1^{.5035}X_2^{.4000}$$

The coefficients can be used as elasticities and indicate diminishing returns to each feed, and for both feeds in combination, since their sum is less than 1.0.

Had production function seven alone been acceptable (e.g., were the reader unwilling to accept anything but constant rates of substitution, and the coefficients for X_1 and X_2 were both significant at the one percent level of probability) the implications would have been these:[13] Feed and grain substitute at constant marginal rates, and hence feed costs per 100 pounds of milk, can always be minimized by feeding grain alone (no hay) or feeding hay alone (no grain) except when the grain/hay price ratio is equal to the (constant) marginal rate of substitution. Costs would then be equal for any possible combination of hay and grain and economic limits to level of output per cow would not exist. These conditions are not consistent with the logic of production economics and previous findings in animal nutrition. Production function one implies none of these conditions, as will be pointed out later. Also, while production function seven allows constant rates of substitution between feeds, it also implies that output can be increased indefinitely as feed input is extended. The latter condition causes us to reject acceptance of constant substitution rates. Production functions three to six inclusive were all rejected in terms of statistic probability, as well as production economics logic.

Iso-Product Contours or Feed Combinations

Equations which represent the empirical counterpart of the iso-product contours (*ab* and *cd* in Figure 1) can be derived for each of the production functions. These allow milk output to be held constant while the values of X_2 (grain) are solved for the various values of X_1 (hay) and can be used to derive the amount of grain associated with each level of hay feeding. This indirect approach to the contour (feed combination) equation was employed since it not only conforms to production logic, but also elimi-

[12] The value of t for β_1 is 2.29 and for β_2 is 2.49.

[13] The linear equation is $.144684X_1 + 1.10340X_2 - 23.6$ with a t value of 4.28 and 7.45.

nates the need for considering either feed as the independent variable (and hence obtaining either one of two curves depending on the direction errors are minimized) were the equation derived directly. By algebraic simplification the iso-product contour thus becomes as follows for production function two with milk at 8,500 and 9,500 pounds per cow respectively:

$$(8500)\ X_2 = \frac{1}{.045774}(5.4937 - .057101X_1) \pm \sqrt{5.7393 - .1840X_1 + .001520X_1^2}$$

$$(9500)\ X_2 = \frac{1}{.045774}(5.4937 - .057101X_1) \pm \sqrt{6.6548 - .1840X_1 + .001520X_1^2}$$

While these feed contour equations result in diminishing rates of substitution between forage and grain, we employ those derived from equation one for the reasons outlined earlier. The contour equations then become as follows, with milk output per cow at 8,500 pounds:[14]

$$X_2 = \left(\frac{8500}{3.56X_1^{.5053}}\right)^{2.5}$$

It is now possible to derive equations for the marginal rates of substitution of hay and grain. The equation listed below is the first derivative of the contour equation and indicates the rate of change in X_2 (grain) for each one unit change in X_1 (forage).

$$\frac{dX_2}{dX_1} = \frac{.5035X_2}{.4X_1}.$$

---

[14] The equation for marginal rates of substitution for production function two are as follows:

$$(8500)\ \frac{dX_2}{dX_1} = \frac{-.1840 + .003039X_1}{.0915\sqrt{5.7393 - .183984X_1 + .001520X_1^2}} - 1.2475$$

$$(9500)\ \frac{dX_2}{dX_1} = \frac{-.1840 + .003039X_1}{.0915\sqrt{6.6548 - .183984X_1 + .001520X_1^2}} - 1.2475.$$

The marginal rates of substitution for production function seven are given by the equation

$$\frac{dX_2}{dX_1} = -.14468.$$

Empirical Estimates and Interpretation

By employing contour equations from production function one and setting the quantity of hay at different values (Column One), we have solved for the quantity of grain in producing 8,500 pounds of milk (from the contour equation). These are presented (Column Two) in Table I. The marginal rates of substitution (the equation representative of the first derivative) are given in Column Three while the reciprocal in Column Four "indicates" the pounds of hay required to replace each pound of grain (with milk output constant at 8,500 pounds per cow for the year) for each combination of feeds. The level of 8,500 was selected because it represented an observed output from the greatest number of cows. The extreme ranges of hay used in Table I are within the observed ranges for cows producing near the 8,500 pound level.

TABLE I. GRAIN-FORAGE ISO-PRODUCT CONTOUR (FEED COMBINATIONS AND MARGINAL RATES OF GRAIN-FORAGE SUBSTITUTION) FOR MILK OUTPUT LEVEL OF 8,500 POUNDS

Feed combination for producing 8,500 pounds of milk (iso-product contour)		Marginal rate of substitution of hay for grain dX_2/dX_1 or pounds of grain for which one pound of forage substitutes)[a]	Pounds of hay required to substitute for one pound of grain[b]
Lbs. of hay X_1	Lbs. of grain X_2		
(1)	(2)	(3)	(4)
5,000	6,154	−1.55	.65
5,500	5,454	−1.25	.80
6,000	4,892	−1.02	.97
6,500	4,423	− .86	1.17
7,000	4,029	− .72	1.38
7,500	3,694	− .62	1.61
8,000	3,406	− .54	1.87
8,500	3,156	− .47	2.14
9,000	2,937	− .41	2.43
9,500	2,744	− .36	2.75
10,000	2,572	− .32	3.09
10,500	2,419	− .29	3.45
11,000	2,281	− .26	3.83
11,500	2,157	− .24	4.24

[a] The marginal rates of substitution refer to exactly the points on the contour indicated in Columns 1 and 2. They are not averages between points.
[b] Column 4 is the reciprocal of Column 3.

Farm Application

The production function employed in deriving the estimates of Table I implies diminishing returns to feed inputs irrespective of the ration fed (hence, increasing marginal costs as output is extended to higher and higher levels). More important for the problem here, the derived statistics indicate a diminishing marginal rate of substitution of forage for grain for any one level of output. The implications of our contour are these: Feed

costs can be minimized (for a given output of milk per cow) by a grain-forage ration wherein the ratio of grain/hay prices (or the cost ratios, if the feeds are to be produced on the farm) is equated (inversely) with the marginal rate of substitution of hay for grain. With milk output at the rate of 8,500 pounds per cow, and with grain at 1.16 cents per pound and hay at 1.0 cent per pound (a ration of .86:1.0), feed costs (whether the feeds are bought in the market or raised on the farm) per 100 pounds of milk are at a minimum, with a ration including 6,500 pounds of hay and 4,423 pounds of grain (where hay substitutes for grain at the ratio of .86:1.0). A grain-forage price ratio of .36:1.0 would specify a ration of 9,500 pounds of hay and 2,744 pounds of grain for minimum costs. The farmer has, of course, two conditions to attain if profits are to be maximized in milk production. One is the minimum cost method of producing a given output of product (equating substitution ratios and price ratios for the factors). The other is the maximum profit level of feeding a given ration (equating the rate of transformation of feed into product with the price or cost ratio of milk and feed).

If forage substitutes for grain in the rotation at a constant rate of 3.83 pounds of hay to 1.0 pounds of grain, milk output (with each cow producing 8,500 pounds) can be maximized from a given land area with a ration including 11,000 pounds of hay equivalent and 2,591 pounds of grain. A rotation substitution rate constant at .97 hay:1.0 grain specifies that a ration of 6,000 pounds of hay and 4,892 pounds of grain will maximize milk production from a given land area (since .97 pound of hay is required to replace one pound of grain with this ration). If grain and forage substitute at a diminishing rate (with or without a complementary range) in the rotation, then the marginal rate of grain-forage substitution must be equated with their marginal rate of substitution in the dairy ration in order that milk output be maximized from a given land area.

Minimization of feed costs is not of sole importance in dairy production because of the costs of labor involved in holding rations in fixed combinations. Grain can, however, be fed in limited quantities with hay fed free choice. Here the cow is allowed to produce at her maximum capacity, once the grain allowance is given. Since the maximum level of output attainable from a high forage ration is lower than that for a high grain ration, the optimum feed combination becomes a complex problem.

Product contours with milk at 8,500 and 9,000 pounds per cow are shown in Figure 2. These contours represent single vertical points on the total production surface (two of a family of contours). Their slopes (marginal rates of substitution of grain and forage) differ depending on the level of milk production per cow.[15] The dots on the graph indicate

[15] While any one of an entire family of contours (vertical points on a total produc-

the observations for individual cows. They have been located at approximately the forage-grain combination fed each cow. The figure by each dot represents the amount of milk (in 1,000 pounds) produced per cow.[16]

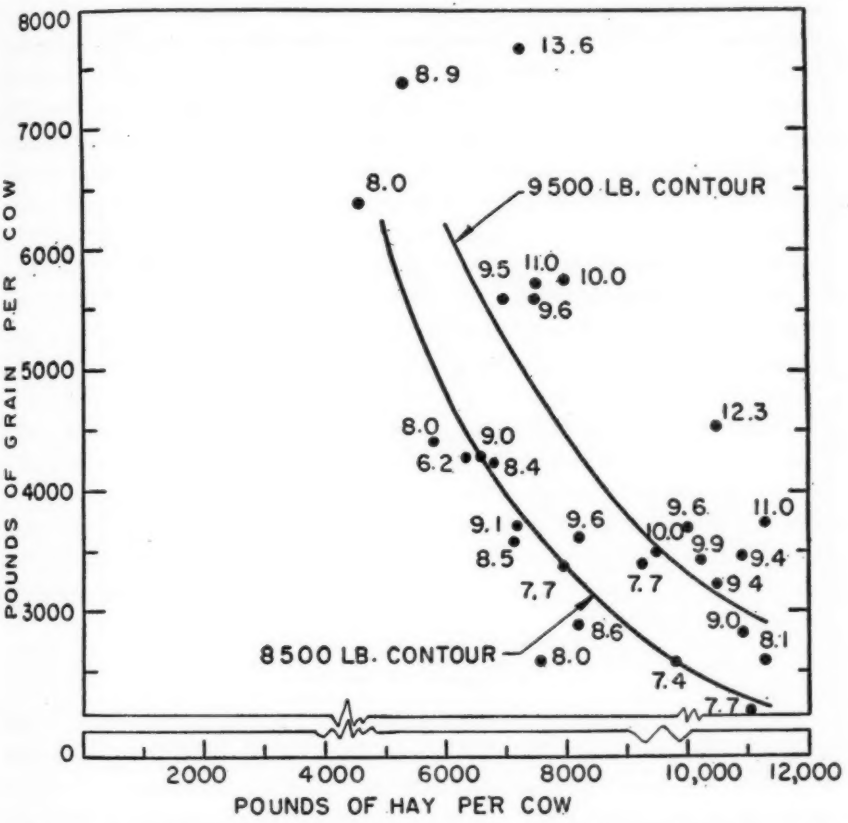

FIG. 2. PRODUCT CONTOURS (FEED COMBINATIONS) AT 8,500 AND 9,500 POUNDS OF MILK PER COW, DERIVED FROM EXPERIMENTAL DATA WITH PRODUCTION FUNCTION 1. (DOTS SHOW INDIVIDUAL OBSERVATIONS WITH FIGURES INDICATING MILK PER COW IN 1,000 LBS.)

Other Notes on Derivation

Data have been derived only for feed and output levels falling within

tion surface or feed combinations for various outputs per cow) can be derived from the data, inspection of the original observations and derived estimates suggest that the regression equation "has meaning" only for contours representing an output of 8,500 to 9,500 pounds of milk per cow. Cows in the experiment not only consumed feeds in the proportions indicated in the range of Table I, but the milk output per cow fell mostly within 8,500-10,000 lb. range.

[16] One observation which included a milk output of 5,046 pounds and inputs of 9,988 pounds of hay and 677 of grain is not shown on the graph.

the observations of the experiment. The observations fall more in the direction of "high grain" rather than "high forage" (the purpose of the original experiment). Forage production problems can only be solved as wider ranges of observations are available at greater extremes in feed combinations. The data employed provide an estimate over a very narrow horizontal "slice" or "band" of the total production surface. While the data for all cows in the experiment perhaps represent a "diagonal movement" over one horizontal slice of the surface (from the bottom of the high-forage extreme to the top of the high-grain extreme), the particular sample of cows used in the analysis evidently represented a great enough variation over the entire slice to allow significant regression coefficients for the original production function. However, to the extent that vertical "movements up" the production surface are confounded with "movements around" the surface in the estimates derived, final determination of substitution rates will have to await other experiments wherein the attempt is made to isolate contour lines rather than "capacity" lines.

Perhaps still other functions need to be fitted to data of the nature available. Some persons extend the hypothesis that rates of substitution may be nearly constant in the mid-section of the product contours, with sharply diminishing substitution rates at both ends. Physical data show that a small amount of grain added to a full forage ration does have a stimulating effect on milk production and thus would cause substitution rates to vary (since additional increments of grain do not have effects of the same magnitude).[17]

Physical Research

The analysis above has necessarily been limited to data of the kind and nature available. However, the implications of the derived coefficients are clearly evident. Additional data of the form presented should be obtained in the various State Experiment Stations, if solution to feed production-utilization is to be provided on an extensive basis. While many of the crop rotation and animal feeding experiments provide basic data which are helpful in deriving the relevant structural relationships, most are not so designed (because of limited funds and other considerations). While designed on an iso-quant (equal quantity) basis, the "given quantity" is usually time or variables other than product. Figure 3 can be used to contrast the nature of the conventional experimental design with that which might be employed were the objective one of deriving

[17] See Saarinen, Sami, Shaw, and Moore, "The Adequacy of an All-Alfalfa Hay Ration for Milk Secretion," *Journal of Dairy Science*, Vol. XXXIV, Apr. 1951, and Huffman and Duncan, "The Nutritive Value of Alfalfa Hay," *Journal of Dairy Science*, Vol. XXVII, 1944.

relationships of the nature outlined here. I_1P_1, I_2P_2, I_3P_3 and I_4P_4 are (conceptual notions or models of) iso-product curves (each representing a different level of output) such as those discussed previously, and can be looked upon as several contours from a total family of contours on a production surface. However, the conventional design is more nearly expressed in a curve such as CN which also might be termed an iso-quant (equal-time, equal-capacity, equal grade, etc.) curve. Hogs, for example, are fed a few different rations (points such as a, b, c, d) for an equal period of time. Analysis of variance is generally employed to test significance of differences between total or daily gains. Where the number of observations is small, estimates of substitution rates are impossible, since these are confounded with transformation rates for a given ration. Even on the basis of designs of this nature, production functions and product contours can be derived from the resulting data if observations are great enough both for numbers of feed combinations and output levels (hog weights, level of milk production, etc.).

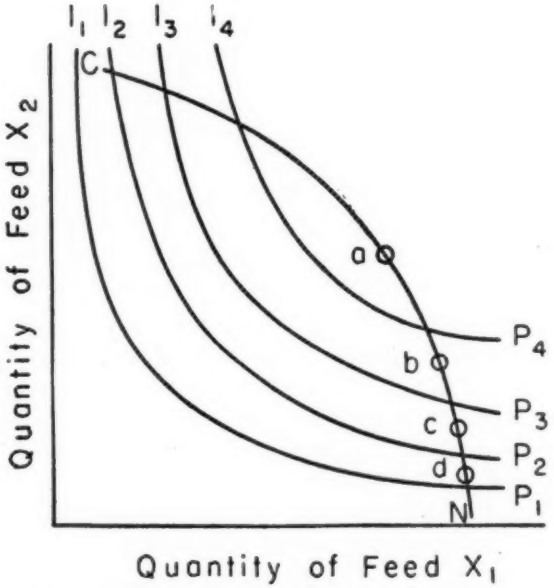

FIG. 3. (HYPOTHETICAL MODELS OF ISO-QUANTS)

Animal husbandmen, agronomists, and production economists might well work cooperately, were the several structural relationships (which are simultaneously necessary for establishing the optimum combinations of farm resources) to be estimated. While many of the phenomena are of physical nature, models (basic logic) which are helpful in experimental

design can also be drawn from production economics. Studies based on models of this nature would generally represent a departure from conventional experimental designs. For example, animal feeding experiments might be designed to provide estimates of a product contour or an entire production function (production surface). Experimental designs of this nature would imply (a) use of individual animals for estimating numerous points on a contour (such as I_1P_1, I_2P_2, etc. in Figure 3) rather than replications of two or a few lots for a very few points (as a, b, c and d) on a hybrid curve such as CN (which does not clearly establish either the feed substitution rates or the feed-product transformation coefficients) and (b) use of regression analysis to estimate the structural relationship (the entire feed contour or production surface) instead of analysis of variance to establish "differences between means" (a very few points on one hybrid curve).

SOIL AND LAND CLASSIFICATION

CHARLES E. KELLOGG
Department of Agriculture

THE term "land classification," even when qualified to "rural land classification," has been used to cover a wide range of products. Clearer distinctions between soil classification and land classification, and between the classification of areas defined in physical terms and that of areas bounded by property lines or other cadastral survey lines, would help enormously. For some classifications it is essential to keep the physical data and interpretations separate from economic criteria; in others, the two sorts of data should be carefully integrated.

Since the attributes of place are exceedingly numerous, many kinds of specialists have contributions to make to a study of land. The criteria chosen for a classification of land areas may include only one feature, various combinations of two or more features, or interpretations of features either strictly or loosely defined, not the features themselves. Land classes, and their delineation on maps, may be displayed in meticulous detail or in broad sweeps. The standards may be relatively fixed or ephemeral.

Classification of land areas varies widely according to purpose; and to achieve the same purpose, the attributes of place are integrated differently and given different weights within unlike combinations.

Scientific classifications of the natural features of areas are often interpreted for use in rural land classifications. Soil classification is the most important of these. Although its chief purpose—to make the optimum application of the results of agricultural research and experience to fields, farms, ranches, and forests according to the kind of soil—is not commonly regarded as land classification, the soil survey provides the basic data for a wide variety of soil groupings for specific purposes that are called land classifications. But if one of these special or limited purposes dominates the soil classification to the point of overemphasizing certain soil features and neglecting others, the soil survey fails in its main purpose and does not provide the basis for other soil groupings or land classifications for important purposes besides the special one.

It is not surprising that confusion exists about soil and land classifications and that part of the total effort is ineffective. Yet the need for soil and land classification is becoming increasingly urgent if full use is to be made of the rapidly growing body of scientific knowledge essential to efficient land use and management.

The author would like to propose some principles that may help to clarify a part of the difficulties, as follows:

(1) Recognition that "soil" and "land" are basically different concepts. The first is a term in natural science and the second a term in social science. Kinds of soil are areas defined in terms of the features relevant to their genesis, to plant growth and use, and to their physical behavior. Kinds of land are areas or tracts defined in terms of the features and relationships relevant to their use by firms and to their value as property.

(2) Kinds of soil, or classes, are *defined* in terms of observable features and *interpreted* in terms of such qualities as fertility, erodibility, and yield expectancies under physically defined sets of management practices.

(3) In a proper soil survey, all features of the soils are considered in order to recognize the significant combinations of them as named kinds of soil in a general system of classification. Only in this way can our knowledge of soil behavior be synthesized for application. Besides serving as the link between agricultural research and farms, such a survey carries the basic data for grouping soils according to the qualities important to soil use and for rural land classification.

(4) Classification is useful whether or not it is displayed on maps. The mere notation of selected features in unclassified and unnamed areas on maps should not be mistaken for classifications. Such a procedure avoids it.

(5) The design of useful interpretive soil groupings, or other taxonomic groups, depends on their purpose. Those designed for one *specific* purpose can rarely be used for another, and some of them cannot be used for the same purpose in a different institutional environment.

(6) A sharp distinction is needed between the taxonomic classification of areas without regard to location, size, and other economic characteristics of place, and the classification of properties or tracts of land according to their potential productivity by firms. The author suggests limiting the term "land classification" to the second kind of classification. Those of the first kind should be called soil classification, vegetation classification, or relief classification, or whatever defines them.

Soil and Land

Both "soil" and "land" are old words. Like "stone," "house," and similar common words, they are hard to define precisely; yet we should reduce the overlap as much as possible.

First of all, "soil" is a term in natural science. Plants grow in it out-of-doors. Many kinds of soil exist. They are defined in physical, chemical, and biological terms.

"Land" is a term in social science. Land is property. It connotes the space within which production takes place. Besides natural qualities that influence response to management, "land" connotes location in relation to

cultural features, property rights and boundaries, and the whole collection of characteristics of place relevant to the concept and operation of a firm.

Both terms are very broad. We might argue that "land" includes "soil" and more; but this would be highly theoretical and far removed from useful working concepts. Unlike kinds of soil associated in a wild, inaccessible place, and greatly different in natural vegetation and in cultural potentialities under a changed institutional environment, could be regarded properly as one kind of land at present. But, of course, the natural scientist would name them as distinctly different kinds of soil. A city lot may contain two kinds of soil with differences of great importance to the occupant as a gardener, but not to him as a property owner. Here the factors associated with "property" are so dominating that characteristics easily recognized by the soil scientist and of great importance to the gardener lose their relevance.

Thus, any manageable classification of land can deal only with rather broad interpretations of soil qualities, not with the individual soil characteristics themselves. Yet it is to combinations of soil characteristics, or kinds of soil, that farmers and gardeners must accommodate their cultural practices.

The term "land" is used loosely a great deal where economic criteria are not taken into account and where "soil," "kind of soil," or "group of soils" is the correct term. This use of "land" for "soil" grew partly out of the mistaken idea that "soil" referred only to the more or less loose material moved in tillage or to the succession of layers called the soil profile. People spoke of soil *and* topography or soil *and* slope, as if they were independent variables. Actually, of course, slope is one of the characteristics of the soil. So are stoniness, depth, temperature, and moisture content, even though none of these is preserved in samples of soil horizons brought into the laboratory.

A soil is three-dimensional. It has depth, shape, and area. Its depth reaches to the limit of biological forces. Its sides are boundaries with other soils where there are changes in one or more of the genetic factors responsible for its nature—climate, living matter, relief, parent rock material, and time. We could no more bring a soil into a laboratory than we could a volcano, a river, or a glacier. We bring in samples of parts of soils for many useful studies. But the results of these must be integrated with the other characteristics of the soil—slope, depth, and so on—before useful predictions can be made.[1] All the physical, chemical, and bio-

[1] The present working concept of "soil" and its implications in soil classification and soil use are explained in considerable detail in the new edition of the *Soil Survey Manual*, Agricultural Handbook No. 18, 503 pp., illus., U.S.D.A., Washington, 1951.

logical factors that influence the response of soils to cultural practices are involved in the definitions of the kinds of soils.[2]

Thus, taxonomic groupings of kinds of rural areas according to those characteristics or qualities (inferences from characteristics) that determine their use-capability for the growth of crops, grasses, and trees, apart from the economic characteristics of place, are more adequately called "soil groupings" than "land classes." The classification of tracts of land, as defined in a cadastral survey, according to use-capability, considering the present or potential institutional environment, is properly called a land classification. Kinds of soil defined in a soil survey may be grouped, for example, as to general productivity for crops according to standards defined in terms of current practices. Such soil groupings may then be integrated with distance to market and the other economic characteristics of properties in a land classification for tax assessment.

A distinction needs to be made also between "soil use" and "land use." The former connotes the present or potential uses of kinds of soil; the latter, the present or potential uses of properties or tracts of land by firms. A farmer uses soil for pasture and corn; he uses land for dairying.

Definition and Interpretation

The contrast between definition and interpretation of classes may be illustrated with soil classification:

A kind of soil in soil classification is *defined* and named in terms of a combination of soil characteristics that can be observed by the classifier in the field. For a soil to be "Miami silt loam, sloping phase," for example, the degree of each relevant characteristic is limited to a defined part of the range of such a characteristic. These features include color, texture, structure, consistence, reaction, and thickness of each layer or horizon of the soil, depth of soil (including extent of erosion, if any), parent material, slope, stoniness, and content of various salts.

Yet for prediction—the purpose of soil classification and maps—one is less interested in the observable characteristics than in the inferences from them. Even such obvious soil features as texture and slope tell us little, unless we know the other characteristics that are combined with them. Soil color has almost no direct significance, but when defined in combinations of soil characteristics it greatly aids inference.

By *interpretation*, the kinds of soils may be grouped into classes defined

[2] Although climate is an important genetic factor and each kind of soil has a characteristic range in temperature and moisture, methods are not sufficiently precise to account for all variations in climate within the definition of a kind of soil that are significant to its use. Differences in local frostiness and wind hazard are examples. Besides that, in the present state of soil classification, some kinds of soil have significant ranges in temperature and moisture that are not associated with more permanent observable characteristics.

in terms of qualities. From properly defined sets of soil characteristics a whole series of important qualities may be inferred. Neither drainage nor fertility can be observed in the course of a survey; they are inferred from observations. The adaptabilities of specific crops, needs for maintaining fertility or tilth, erosion hazard, lime requirement, and yield expectancies under defined management are other very important inferences that cannot be observed directly nor used to define kinds of soil.

With kinds of soil defined in terms of observable features, their qualities may be interpreted by inferences based upon results of research and farm experience and the known principles of soil science that relate combinations of characteristics to plant growth and soil behavior. Management practices are investigated through standard plot techniques on sample areas of defined kinds of soil, for example, in order to get data for interpretation and appraisal of qualities. Also useful are the results that farmers have had on specific fields that can be correlated with kinds of soil and sets of management practices.

Attempts to classify soils in the field by inferred qualities rather than by characteristics lead to hopeless confusion. The soils in the field may appear to be erodible or non-erodible, low or high in fertility, or well or badly suited to a particular crop for several different reasons. The observed results are due to interactions between a combination of soil characteristics and a set of management practices. Classification and mapping on the basis of inferences made at the spot have little prediction value. Due to differences in management alone, there are poor farms, good farms, and brushland on different tracts of the same kind of soil, all with identical potentialities. Such observations are useful in interpretation, but are worthless as criteria for classification and mapping.

The author recalls a "soil survey" made many years ago under instructions to be highly "practical." The soil mappers were told to classify the soils into various classes according to their on-the-spot estimate of their productivity for wheat. This they did. I have no doubt they made a good map for the moment. They knew a great deal about the relation between combinations of soil characteristics and the performance of the varieties of wheat then grown in the area and the cultural practices farmers were using. But these did not stay fixed. Superior, higher-yielding varieties were introduced that had different relationships to the soils. Cultural practices changed. The result was that the kinds of soil had a changed relative advantage for wheat-growing. The map lost its prediction value and became worthless. It couldn't be fixed because the relevant characteristics had not been mapped. Where the kinds of soil are mapped according to their characteristics, as in a proper soil survey, it is a simple matter to reinterpret them and regroup them in terms of such changes in the agricultural arts.

Classification of land according to present use can lead to great misunderstanding, and has. Here again, the observed result is due to the interaction of many factors. Although within a given small universe, condition of farm buildings or intensity of use, let us say, may correlate generally with soil capabilities, these relationships do not hold in individual cases. Since present use depends on so many economic factors, one has no measure of what the capabilities of the land would be within a different institutional environment.

Similar or even identical soils in Hawaii and in Central Africa could have completely different present uses. An observer not understanding soil fertility could easily come to the erroneous conclusion that the soil in Central Africa has a low capability because indigenous farmers have low yields and poor homes. And it does have under their management. Yet an identical kind of soil in Hawaii, let us say, managed by a skillful agriculturist with access to fertilizers and other materials, may produce abundantly.

Yet classification according to present use can be useful, if not prejudiced by supposed correlations with causes. If use classes are precisely defined, especially in terms relevant to intensity of *present* use, a comparison of such a classification and map with one for the same area made by grouping kinds of soil according to use capabilities helps greatly in the identification of the limiting factors, many of which turn out to be institutional.

Requirements of a Soil Survey[3]

Soil surveys may be regarded loosely as a kind of land classification. Although the soil survey does not include all characteristics of place, it recognizes a larger proportion of the ones relevant to local soil and land use, and more accurately, than any other survey systematically carried out over large areas. But as the term "land classification" is most commonly used, it refers to something far less complete and detailed than the modern soil survey.

Each kind of soil has its own particular set of characteristics. Through research and interpretation, its capabilities for use and response to management can be discovered and can be expressed in terms of yields of adapted crops under defined sets of practices. These are the basic figures for calculating outputs and inputs.

A kind of soil, accurately defined and named in a standard system of classification, is the only reliable basis yet found for selecting samples of soils and landscapes for experimental study, and for synthesizing the re-

[3] The technical requirements and standards for soil surveys and for their interpretation are set forth in great detail in the new edition of the *Soil Survey Manual, op. cit.*

sults so they may be applied to fields and farms. Thus, the soil survey is the connecting link between agricultural research and the individual farm fields.

The soil survey gives predictions rather than recommendations. Recommendations depend upon the kinds of soil, the economic environment, and the operator. Given an accurate soil map of a farm, with adequate predictions about the crop yields and behavior of the soils under alternative sets of management practices, the optimum system for efficient sustained production can be developed that fits the economic characteristics of the farm, the soil pattern, and the skill and resources of the operator.

Since decisions about farming practices are made within millions of individual managerial units, or firms, the classification must be detailed enough to include all the significant soil characteristics—all basic factors that significantly affect soil use and management. The soil maps must be detailed enough to indicate areas significant to a farm management system and show them accurately in relation to local reference points that are indicated on the map and that the user can see on the ground. Obviously, a soil survey detailed and accurate enough for this purpose furnishes most of the basic physical data required for rural land classification.

To fulfill the function of the soil survey in the improvement of agricultural efficiency, research is required to determine the significance of the various combinations of soil characteristics. These characteristics do not vary completely independently, but are associated as kinds of soil. The significance of any one feature depends upon the others in the combination. Both known and previously unknown combinations of soil characteristics are continually under study in the light of our present knowledge of soil-plant relationships and results of both field experiments and farm experience. This knowledge of the influence of the various soil characteristics in the many combinations is still not sufficiently developed to permit the satisfactory routine use of fixed schedules or "score cards" for appraising soils.

A few of the principal requirements for a useful soil classification may be summarized briefly.

(1) A standard system of soil classification and nomenclature is essential to useful soil mapping. No matter how intensive and significant, the results of the research carried out at one spot can be transferred only to other like spots by a common definition and name of the kind of soil. So very many features combine to make a soil a certain kind that accurate descriptive names are impossible (except to differentiate among soils locally that have many characteristics in common).

(2) A soil classification must be solidly based on defined natural units so they may be generalized into groups of progressively higher categories

on the basis of differentiating characteristics of increasing importance to their identity.

(3) Soil classification must comprehend all characteristics that are known to result from significant differences in genesis or are known to have significant influences on soil use and behavior. The great practical importance of many distinctions among kinds of soil was not known to the soil classifier who first made them.

We can classify things only on the basis of what we know about them; as our knowledge grows, we are bound to add criteria and to give characteristics changed emphasis in various combinations in order to improve our predictions.

A basic soil classification is complicated at best. It cannot be made simple in the sense of having a few easily recognized kinds of soil. The variation in nature is fixed; failure to recognize it in no way reduces it. For any specific purpose, however, soils may be grouped *by interpretation* into a few easily defined classes.

Mapping and Classification

So many uses of both soil and land classifications require maps that many have unconsciously assumed (1) that classifications are used only in map form, (2) that useful classifications are always mappable, and (3) that notes in map form about soil or land are automatically classifications. None of these is true.

First, soil scientists would need a soil classification fully as much if there were no soil maps. Classification is essential for synthesizing knowledge, for remembering soil characteristics, for visualizing relationships, and for developing principles. To apply the principles of soil science (and of many in agronomy, horticulture, economics, and other fields) to a place, someone must identify the kind of soil. Soil mapping is simply an orderly, efficient way to get the kinds of soil accurately identified. Many people can use the principles and predictions tied to the soil classification who could not themselves identify the soils.

To take another example, farms or other land tracts can be usefully classified for various purposes whether or not their location and identification are made through the use of maps.

Second, highly contrasting kinds of soil frequently occur in such intricate patterns in small areas that the separate kinds cannot be shown on a map, except at scales so extremely large that the maps are too unwieldy and too costly to be practicable. Still, their classification and recognition are necessary. Under such conditions, geographically associated but *unlike* soils must be grouped into mapping units called *soil associations*. On maps of small scale, only soil associations can be shown, not the individual kinds of soil in the taxonomic classification.

Such soil associations are analogous to plant associations. One cannot show on maps the individual species of mixed vegetation, no matter how contrasting they may be. Rather, the ecologist defines associations of plants according to the proportions of the various species. Yet the characteristics of any kind of plant are associated with its taxonomic name.

A soil association is definied by the kinds of soil in it and their proportions and pattern. It is named by joining the names of the principal kinds of soil. From a map of soil associations, the reader does not get the precise identification of the kind of soil at a particular spot. The map tells him that the soil is one of two or more kinds that are unlike. The explanatory text tells him how to see which one it is when he looks at it on the spot. Perhaps the map covers an area with 200 kinds of soil. For a particular spot, it narrows the range for the reader to decide among only a very few.

Kinds of soil are also grouped taxonomically according to similar differentiating characteristics, say the local soil types and series into soil families and great soil groups; or by interpretation, according to lime requirements, erosion hazard, or some other quality.

Where unlike kinds of soil exist in very intricate patterns, no amount of generalization or grouping by common characteristics permits the groups to be mapped separately. Soil associations must be defined for use as mapping units; but this does not reduce the significance of the constituent taxonomic units.

Soil associations as geographic groups of unlike soils must be clearly distinguished from taxonomic groups of similar soils. Both kinds of groups appear on soil maps, particularly on special-purpose maps made by interpretation from the soil survey. Unfortunately, on the older soil maps some soil associations were given the names of the single dominant soil type, even though many other contrasting soils were present in the mapped area.

Third, the most confusing of all are maps purporting to display a soil or land classification, but which are actually maps carrying selected notes of features without classification. Most commonly, these indicate areas by compound symbols with individual numbers or letters, perhaps in a "numerator" and a "denominator," each keyed to a *separate* legend. Thus, we might look at the symbol of a mapped area and find from the various keys that it had the following features: deep soil, slopes of three to eight percent, brown soil, loam surface soil, a corn crop, . . . and so on. But what is the bounded area? We cannot tell what kind of a soil exists from these notes, nor even from a longer list. Any list that would be long enough to indicate differences in the degrees of expression of all features that are relevant in at least some combinations would be most

unwieldy. Then too, division of soil slope at three percent and at eight percent may be quite proper in some combinations, whereas in others six percent may be the critical limit.

These schemes appeal because their use avoids classification and because men untrained in classification can use them. Lacking a regular nomenclature, of course, the map is not useful for translating the results of research into predictions. Yet a map with such a multiple legend, uncontrolled in the sense that any combination of symbols may be used by the note-taker in the field, may have thousands of separate combinations of symbols for an area with only 75 or 100 significantly different kinds of soil.

Classification is a hard job. The classifier must decide what features are relevant. He must develop standard notations for degrees of expression of each feature. He must define combinations of features, with varying degrees of expression, in such a way that each one is given its proper weight relative to the others in the integrated whole. He must test his classification for homogeneity and for omissions and overlaps. Finally, if the classification is to be used on maps, he must test it in the field to be sure that his units are mappable and relevant and that the boundaries among them come at significant places.

The taking of notes in compound symbols on maps avoids this work. Such maps should never be confused with classification.[4]

Purpose in Land Classification

Search for a simple, all-purpose classification of rural land according to all significant characteristics and capabilities is hopeless. A classification can be simple only for an easily defined, narrow, single purpose. In practice, it is most efficient and cheapest to make a basic soil survey from which a great many simple groupings, or "land classifications," may be derived by interpretation, than to concentrate on one narrow, immediate objective at a time, so that a new survey needs to be made each time another problem is given attention.

In the United States alone, we have many thousands of different kinds of soil varying from one another enough to be significant for some interpretation. Any pair may vary widely in several features or, in extreme cases, only a little in the degree of expression of one feature.

According to purpose, a simple interpretive grouping places together in

[4] Where the map has enough paper space for them, connotative compound symbols may be used for classified areas to help the reader select certain individual characteristics or qualities at a glance. Such symbols can never be complete and can be developed accurately only *after* classification. With nearly all maps, however, it is best to use short symbols, so they can be placed within small areas, and to show the selected features or qualities in a table on the map or attached to it.

one class all the kinds of soil that are alike in the one selected feature or quality, quite regardless of how much they vary in other features or qualities.

Let us take an example: Soils may be grouped into an arbitrary number of classes according to their suitability for crops, grasses, and trees. Often, five classes are used, as (1) the very best soils for crops (requiring tillage), (2) good soils for crops, (3) fair soils for crops, (4) soils suitable for pasture but not for crops, and (5) soils suitable only for forestry. Such a grouping has usefulness, but it tells us hardly anything about management requirements for optimum sustained production. Either as a completely separate grouping, or as subdivisions of the five broader use-capability groups, the soils can be placed into groups according to the combinations of rotations, tillage practices, fertilizer use, and so on, that are optimum under present conditions as generalized for all farms. The more narrowly these sets of practices are defined, the larger the number of groups. This serves another purpose.

Even such groups, defined in terms of use-suitability and management requirements, are not so homogeneous in expectable yields as are groups made by putting the soils together specifically according to yield expectancy. If groups are made that are as homogeneous as the data permit according to adapted crops, estimated yields, and management requirements, so many kinds of soil should need to stand separately that the grouping would lose its advantage of simplicity.

Thus, to get the advantage of simple soil groupings, or taxonomic classifications of land areas, one needs to define a narrow purpose *and then not use this grouping for any other purpose.* A simple grouping into five classes according to erosion hazard is useful in indicating this one quality. But, of course, these groups are not homogeneous in soil features or in such other qualities as fertility, productivity, management requirements, yield expectancies, and the like.

To take another example: As a general program guide, soils are commonly grouped into eight classes according to use-suitability with emphasis upon soil conservation.[5] Class 1 includes soils safest to use under intensive cultivation; classes 2, 3, and 4 can be used for cultivation, but with increasing erosion hazard or with other limitations; class 5 is useful for grazing or forestry, although not for cultivation; classes 6 and 7 have increasing limitations for these uses; and, finally, class 8 is not suited to producing crops, grasses, or trees. Even though homogeneous in such

[5] Although commonly called "land capability" classes, these are really soil groups, since only soil features are taken into account, not the other characteristics of place that influence the operation of a firm. *See* J. G. Steele, *The Measure of Our Land,* 17 pp. illus., USDA, 1951.

broad terms, the soils within each class vary widely in characteristics, crop adaptability, productivity, management requirements, and other qualities. As with the simpler five-class grouping, these may be subdivided *locally* according to management requirements.

No matter how successfully such a soil grouping serves one specific purpose, it should not be used for some other purpose, such as the basis for land appraisal, let us say. For example, a pair of soils may be safe to use and still vary so widely in other qualities that, under the optimum management for each, they have entirely different input-output ratios. Another pair may be highly erodible under simple tillage, but not so with the proper combination of tillage, terraces, liming, fertilization, and rotations in which sod crops are prominent. Yet, here again, input-output ratios may be entirely different.

For land appraisal, a soil grouping is needed that reflects the generalized input-output ratios under assumed sets of the commonly used practices. Then, for each tract, the potential use is determined on the basis of all the significant features that influence the management of the tract. Within the uses assigned, the land is rated in terms of capability for those uses, as adjusted for location and, according to local law, for improvements.

Thus, the soil grouping most suitable for this purpose is unique. Nor does it stay fixed. Yet, if the kinds of soil are defined in a basic soil survey, the groupings can be revised and reinterpreted with changes in economic conditions and in the agricultural arts, changes that influence the relative advantage of the different kinds of soil and of the other features in the appraisal.

Even for the same purpose, soil groupings and land classes are defined differently in areas with unlike economic characteristics. For example, a general relationship was found between the quality of soil for crops and tax delinquency in the Northern Lake States, especially because of the general overassessment of soils suited only to forestry. In this area, classification of land tracts according to tax delinquency and whether or not the land is cleared gives a reasonable basis for rural zoning. But use of the same criteria for the same purpose gives inadequate results in areas where assessments have been more nearly in accord with land productivity and where labor for clearing is more abundant.

As a more extreme example, one may compare soil groupings according to productivity in a highly developed country like the United States with those in undeveloped countries in the tropics. Here in the United States, soils are regarded as highly productive if they can be made so with fertilizers and other practices dependent upon modern industry; whereas, in a relatively inaccessible part of the humid tropics, similarly

responsive soils may not be regarded as productive because the products of modern industry are unavailable.

Since soil classification and mapping require a lot of hard work, people are continually looking for "correlations" with vegetation and other surface features easier to see. Thus, many "physical" land classes, which are really attempts at soil groupings, are defined indirectly in terms of vegetation. In some places, the correlations are fairly good and an approximate soil map can be made in this way. Yet perhaps only 100 miles away, where the climate is slightly different, the "good indicator" plants push onto soils unsuited to farming and the maps made on the basis of them are useless for predicting agricultural potentialities. Examples of such errors are abundant.

Taxonomic Classification of Natural Areas vs. Classification of Land Tracts

Failures to distinguish between the classification of soils (or natural land areas), without respect to property lines of cadastral units, on the one hand, and the classification of properties or land tracts as defined in a cadastral survey, on the other, have led to great confusion in the making and using of land classifications. This confusion is often compounded with those of purpose and definition.

By taxonomic classification of soil or land areas, the author means classifications, including interpretive groupings, according to inherent features or qualities, exclusive of location in relation to property lines and other institutional factors. Social features influence this kind of classification only indirectly as they influence the intensity and scope of the research and the purpose.

On the contrary, the classification of tracts of land in ways relevant to use or potential use by firms involves size of tract; patterns of kinds of soil; distance from market, water supplies, and other economic units; and the general level of economic productivity of the area.

The author now believes that much confusion could be avoided by limiting the term "land classification" to the classification of land by tracts. Thus, classifications dealing with areas without respect to property lines and economic features should be named specifically for what they are—classifications of soils, of vegetation, of land forms, of climate, of relief, of soil slope, or soil erosion hazard, or of whatever is appropriate. Perhaps agreement on this use is too much to hope for. Many have used "land" in the sense of soil for so long that the proposed distinction may seem to be academic, and that a more narrowly defined term somehow reduces the standing of their work. Others may prefer the term "land" because it is a kind of "Mother Hubbard" that can include anything.

Vagueness, or perhaps bluffing, causes endless confusion to the users.

Some use "physical land classification" as a sort of compromise. But this involves a clear conflict of terms.

The term "land" connotes use by firms. It cannot be defined in terms of physical characteristics alone. Two tracts having identical physical characteristics, except for location and related features, can have very different potentialities for use and different values. They are different kinds of land.

Before rural land tracts can be classified according to potential productivity, tax assessment, or irrigability, let us say, a use class or combination of use classes must be assigned to them. These include mainly (1) cropping, (2) grazing, or (3) forestry, although some tracts are used also or separately for (4) recreation, (5) mining, (6) public services, (7) wild life preservation, and (8) protection of other land. Some land is *waste land,* not now capable of production; and some is *idle,* not now producing, although capable of it.

The reasonable use class to assign to a tract results from the interactions between its natural features and its economic characteristics. For example, one cannot assign a soil area to use for crops unless it is large enough for an economic unit. In regions of soil dominantly suited only to grazing or forestry, small areas of soils well suited to crops must be assigned to the other dominant uses, except as they may be located strategically at a ranch or forest headquarters. Soils suitable for grazing cannot be so used with full intensity in the absence of a water supply. On the other hand, a small area of soil suited only to grazing or forestry, but surrounded by a large area of soils well suited to crops, may be little more than waste land if no economical management plan can be worked out for it.

Although distance from market does not directly affect classification of taxonomic soil groups, it greatly affects the classification of social land units or tracts. Then too, the distance in miles must be corrected according to transport facilities; poor roads must count more than good roads.

This contrast between taxonomic classification of areas and land classification of specific tracts may be illustrated in schemes designed for classifying land according to irrigability. As the first step, a detailed soil classification and a detailed soil map are made for the area. For planning the layout of projects, the soils are grouped according to their arability under irrigation without regard to location within the area. Such a soil grouping and map predict what would be the result of irrigation for every part of the area. Then, questions need to be raised about the accessibility of specific tracts of arable soils to roads and canals, and about the com-

binations of various soil areas into economic farm units. Some kinds of soil cannot be irrigated economically, of course, because of their unresponsiveness or likelihood of deterioration, regardless of location. Other kinds of soil are highly suitable except where isolated in small tracts that cannot be reached economically by water lines or fitted into a farm unit. Intermediate kinds of soil are classed as irrigable if water could be supplied cheaply and conveniently, but as non-irrigable if water charges are high.

Thus, two quite different maps of the same area, both accurate for their purposes, might be called "land classification according to irrigability." The first one represents the distribution of taxonomic groups of soils and might better be called "a classification of soils according to their arability under irrigation." The second map, made on the basis of the first one, along with consideration of the additional features of location, displays a classification of geographically defined areas, or tracts, and is more logically the one to call "a classification of land according to irrigability." The second classification and second map follow an accurate development of the first ones interpreted from a detailed soil survey.

Besides serving this immediate purpose of developing a land classification according to irrigability, the detailed soil survey is used for developing individual cropping and soil management systems optimum for the specific kinds of soil that are grouped into the more general classes. Had the land classification given recognition only to the factors relevant to the immediate purpose of planning the project, another field survey would be required for the soil map to use in guiding farmers about soil management practices.

The classification of land tracts must take account of those characteristics of place that influence decisions among the land use classes and the judgments about relative intensity of use within the classes. In classifying land for tax assessment, for example, the kinds of soil are first rated according to their productivity under alternative systems of management within each use class on a taxonomic basis. Second, the use classes of the land tracts—sections, forties, or farms—are determined. Third, ratings of the taxonomic groups within the use classes for each land tract are adjusted according to distance from market and the other factors that influence potential production by firms.

THE FAMILY FARM AND THE THREE TRADITIONS

JOE R. MOTHERAL
Texas A&M College

> We know that the peoples of Asia have problems of social injustice to solve. They want their farmers to own their land and to enjoy the fruits of their toil. That is one of our great national principles also. We believe in the family-size farm. That is the basis of our agriculture and has strongly influenced our form of government.
>
> —HARRY S. TRUMAN
> October 17, 1950

THIS statement might be construed as merely another expression of sentiment in behalf of a great American ideal. A favorite topic of political aspirants since colonial days, the family farm principle is by no means a new discovery. Yet it is significant that in a direct plea to the "peoples of Asia," the President of the United States places the family farm uncommonly high on the roster of man's common objectives. The discovery, if there is such, arises out of a growing awareness of the universal appeal of land reform as a weapon in a world-wide ideological struggle. While the President's emphasis upon ownership and size of farm is debatable, the enormous appeal of the goal of widely distributed rights in property is beyond dispute. Among the many attributes of the family farm is that of its power as a psychological instrument.

This paper is concerned with three main propositions. First, of all the units of our complex society, the family farm is unique in having become, over the years, the vehicle of three distinctive values that lie at the heart of American tradition. In fact, each of these values is itself a tradition, stemming from a different creative epoch in the development of western society. The oldest of these is the agrarian tradition—the feeling that a peculiar property of goodness arises from the relationship between the soil and the man who tills it. The next oldest is the democratic tradition —the conviction that the family farm is an especially effective mechanism for developing the spirit and habits of responsible citizenship. Last and youngest is the efficiency tradition—the belief that waste is somehow sinful and that any self-respecting man is duty-bound to combine effort, skill, and substance in such a way as to get the most possible from every resource at hand.

Second, these three traditional values all enter into almost everyone's concept of the family farm with such different weights and emphases as almost to preclude, on first sight, any common conception of a family farm that is sufficiently definite and adequate for either policy-making or

research purposes. Third, on further scrutiny, however, this difficulty is more academic than real—more the preoccupation of intellectuals than of those with a real job to do. For, while general agreement is difficult to secure on what a family farm *is*, it is fairly easy to itemize what it *is not;* and use of even these negative criteria would go far in correcting many mis-handlings of farm statistics, particularly census data.

Broadly viewed, the family farm concept is strongly suggestive of a basic human want. Whether the want is defined as a desire for land, for security, for favorable living conditions, or for such intangibles as "independence," is subordinate to the fact that it exists throughout the world. Man's persistent aim to possess secure rights in land makes its appearance in every country and throughout every period of history.[1]

After a fashion, the development of the family farm ideal in the United States may be abstracted from its counterpart elsewhere, for here the concept has acquired certain characteristics which, despite the universality of land hunger, make for a distinctly American product. For the purposes at hand, our interest centers on this American ideal. The three factors named above help to explain its origin and present status. Briefly to recapitulate, these are: a) the agrarian tradition, b) the democratic tradition, and c) the efficiency tradition. Fortunately, these three traditions may be identified with separate time dimensions that tend to set them apart. Unfortunately, their combination into a single conceptual framework has proved to be a clumsy intellectual adventure, and more often than not, the attempt has resulted only in confusion. While no analysis can resolve the divergent and many-sided views that revolve about the family farm ideal, a brief examination of the three traditions should help at least to delineate the extremes.

The Agrarian Tradition

The agrarian tradition ascribes a peculiar property of goodness to the relationship between the soil and the man who tills the soil. This conception preceded, then accompanied, centuries of devotion to natural law. Unless challenged, the agrarian tradition is not scornful of worldly considerations; rather, it is inclined to ignore them in favor of certain profound, though variously defined spiritual values. As far back as recorded history permits one to conjecture, agrarianism has occupied a prominent place in the lives and the literature of men.

Among the ancients, there were at least three explanations for the powerful influence of the agrarian tradition. Direct agricultural production and the virtual survival of society were so closely related as to be

[1] The "family farm ideal" and its various corollaries are phrases of convenience used to designate this common tendency.

UNIVERSITY OF MICHIGAN LIBRARIES

inseparable. Proximity to the miracles of nature and the life processes, then as now, had an awe-inspiring effect upon all people. Finally, as farming was the only recognized productive endeavor, its supreme virtues were rather naturally the subject of acclaim by those who were utterly dependent upon the land for their continued existence. Aristotle and Xenophon, among the Greeks, were eloquent spokesmen for the agrarian tradition, while Cicero, Virgil, Horace, and Cato sang the praises of the Romans for the humble tiller of the soil. The Graeco-Roman addiction to agrarianism was summarized by Aristotle in these words:

> Husbandry is the mother and nurse of the other arts. For when husbandry flourishes, all the other arts are in good fettle, but whenever land is compelled to the waste, the other arts well nigh perish.[2]

The pseudo-sacred role of farming held its place through the centuries. It received scientific reinforcement at the hands of the Physiocrats—Quesnay, Mirabeau, and Dupont in particular. Large landholdings were being viewed with suspicion by the French at the time, and the Physiocrats, large landowners themselves, were not averse to adapting the agrarian tradition to their own impeccably respectable needs. That the idea was associated with large farms during this period is merely evidence of expediency—the relapse to a small farm base was as rapid as it was inevitable. Jefferson was the most influential carrier of the agrarian tradition into the American colonial setting, although the Jeffersonian adaptations were highly portentous of a modern and distinctively American brand of philosophy. In its unadorned form, Jefferson's love of the land was expressed in these nostalgic words:

> I have often thought that if heaven had given me choice of my position and calling, it should have been on a rich spot of earth, well watered, and near a good market for the productions of the garden. No occupation is so delightful to me as the culture of the earth . . .[3]

Rural and urban people have not always drawn the same conclusions from the same basic agrarian sentiment. Two notions frequently identified with agrarianism were never held by Jefferson nor, for that matter, by farmers generally, but were foisted on them from the outside. These were the idea of restricting the size of the unit so as to keep as many farmers on the land as possible, and that of placing limitations on fee simple ownership that would "assure" a farm's retention by the family. Among some city dwellers today, and particularly among the labor groups during the pre-emption struggle of the forties, such beliefs have enjoyed considerable currency.[4]

---

[2] Quoted in A. W. Griswold's *Farming and Democracy*, Yale University Press, 1948, p. 19.

[3] *Ibid.* p. 24.

[4] See John R. Commons, *Documentary History of American Industrial Society*, Vol.

There were other forces at work in the colonies, as will be noted presently, but the seeds of the agrarian tradition were planted deep, and its top growth is still to be seen on every hand. American literature offers illustrations in abundance of its cultivation. The romantic poets, such as Longfellow and Whitman, have paid tribute to the unparalleled wonders of nature and of man's great fortune in sharing nature's gifts. The churches, some sects in particular, have persistently cited the merits of farm life as a vehicle for spiritual development. Almost all American politicians have catered to agrarianism in one form or another; both of the major political parties included planks in their 1948 platforms solemnly endorsing the farmer and the family farm. In the social sciences, a whole new discipline, rural sociology, grew out of the conviction that the intangible agrarian values were being neglected for the interests of sheer material production on farms and the new complex of problems in cities. Encroaching urbanization may have dulled, but it has by no means destroyed, the agrarian tradition. As Griswold puts it:

> Only for a brief moment in history and in a few places on earth have men ever known anything but an agrarian environment. Since agriculture was the basic economic enterprise, the traditional calling of mankind, it is not surprising to find it sanctioned by religion, by secular idealism, by whatever forms in which the human propensity for rationalization found expression.[5]

The Democratic Tradition

The European origins of the democratic tradition have been explored in such a competent manner by numerous historians, that it is unnecessary to review them here. Furthermore, it is not the source of democratic forms, but their coincidence with ancient agrarianism in this country, that serves as a backdrop for the family farm ideal. From the standpoint of the development of political economy, the year 1776 may be regarded as the climactic date, producing as it did the American Revolution on this side of the Atlantic and Adam Smith's *Wealth of Nations* on the other.

Jefferson was far more than the voice of agrarianism; he was the genius of the evolving American democracy. Although doubtless affected by the persuasive doctrine of *laissez faire,* he was also deeply concerned about the means of safeguarding an untried system of government. Sometimes described as one part farmer, one part politician, and one part philosopher, Jefferson was hardly disposed to permit his love of the land to confound his sense of realism. Ninety percent of the constituency of this new country were farmers. This happy circumstance allowed Jefferson

---

VII and VIII, The Arthur H. Clark Co., Cleveland, 1910, chap. III; Roy M. Robbins, *Our Landed Heritage,* Princeton University Press, 1942, chap. V-VII; and Benjamin H. Hibbard, *A History of the Public Land Policies,* The Macmillan Co., New York, 1924, chap. XVII.

[5] *Op. cit., Farming and Democracy,* p. 20.

UNIVERSITY OF MICHIGAN LIBRARIES

to engage his agrarian sympathies and his political expressions in a wholly unforced union. His philosophical ruminations, meanwhile, led him to the conclusion that private property rights, widely dispersed, were the safest assurance that democracy would endure.

Thus, it was quite natural that Jefferson should become the architect not only of the American democratic tradition, but of the family farm ideal. And here is to be found one of the most fertile sources of modern confusion. In terms of our times—not his—Jefferson conceived the family farm to be a *small farm.* How could it be anything else when the alternatives were the immense, uncultivated holdings of the joint stock organizations or the slave-operated plantations? Moreover, the status of technology dictated a subsistence culture that, assuming individual ownership, placed an inescapably low ceiling on farm size. The family farm was to give the maximum number of citizens a stake in the total welfare and encourage the full participation in government which Jefferson deemed necessary for its survival. The principle is equally applicable to small units of production in industry, a fact that Jefferson himself recognized before his death, as the nation's factories grew in size and number. In no wise can Jefferson's position be interpreted as the advocacy of an uneconomical scale of operations or as an implied condonance of rural poverty.

Daniel Webster put into a single statement what Jefferson, judging by a score of scattered remarks, obviously believed:

> Our New England ancestors brought thither no great capitals from Europe; and if they had, there was nothing productive in which they could have been invested. They left behind them the whole feudal policy of the other continent. They came to a new country. There were as yet no lands yielding rent, and no tenants rendering service.
>
> The whole soil was unreclaimed from barbarism. They were themselves either from their original condition, or from the necessity of their common interest, nearly on a level in respect to property. Their situation demanded a parcelling out and division of the land, and it may fairly be said that this necessary act *fixed the future frame and form of their government.* (Webster's italics.) The character of their political institutions was determined by the fundamental laws respecting property. The consequence of all these causes has been a great subdivision of the soil and a great equality of condition; the true basis, most certainly, of popular government.[6]

Since colonial days, the land policy of the United States has consistently aimed at unencumbered owner-operatorship of farms. "Attempts to give overt expression to this policy fall into two major groups: (1) the

[6] Quoted in "Small Business and the Community," U.S. Senate *Small Business Committee Report* No. 13, Dec. 23, 1946, p. 3.

manner of disposing of publicly owned lands and (2) public assistance in the provision of credit for private land transactions."[7] Notwithstanding the gap between purposes and consequences, this has been the accepted policy. It was derived straight from the Jeffersonian model, and about it hovered both the aura of the agrarian tradition and the spirit of the democratic tradition.

The Efficiency Tradition

Efficiency is assumed to result from the optimum combination of inputs of entrepreneurship, land, labor, and capital in a productive enterprise; in this instance, in the farm. Primitive farmers no doubt had some crude conception of efficient production, but it is only in comparatively recent times that farmers or anyone else could avail themselves of a formal logical apparatus for production problem analysis. This is the scientific discipline called economics. In its classical form, economics is objective to a mathematical degree, leaving scant room for such emotionally grounded precepts as agrarianism, although its basic premise of free competition is drawn bag and baggage from the democratic tradition.

The efficiency tradition is not exclusively an American innovation. It dates back at least as far as the early agitation over excessive parcellation—and to a lesser extent, concentration—of landholdings in sixteenth-century England. The English enclosure movement was an attempt to attain greater efficiency in agricultural production, as were the first attacks upon the legal doctrines of primogeniture and entail. However, the highest place attained by the efficiency tradition in the folklore of any nation has been reached in the expansive industrial society of the United States. It is perhaps only here that production—efficient production of material goods—has made the philosophical transition from a means to an end, and has been set up, somewhat vaguely, as a rival to eternal salvation.

Defining efficiency to the satisfaction of all concerned is as difficult a task as defining the family farm ideal itself. In fact, the philosophical issues are not too different in either case. At the one extreme, the emphasis is upon intangible values, real or presumed, at the other, upon technological materialism. Critics of the former position condemn it as a rationalization of rural subsistence living or, interchangeably, of poverty, and heap condemnation upon those who would let allegedly spurious ethical considerations interfere with the free flow of resources into the highest

[7] Leonard A. Salter, Jr., in *Family Farm Policy*, edited by Joseph Ackerman and Marshall Harris, University of Chicago Press, Chicago, 1947, p. 123. The full story of the disposition of the public domain is told in *A History of the Public Land Policies*.

combination of uses. Critics of the latter position argue that "efficiency" is a dangerous catchword that obscures certain fundamental relationships, notably those of an institutional character, and that economy of production cannot be measured adequately without regard for the farm's function as a development center for a high proportion of the country's population. These are only sample arguments, of course, as the debate becomes much more intricate when the issues are examined in detail.

In this connection, one distinction is worthy of further comment. A farm *is* unique in the sense that it is both a producing unit and a home, often with a very hazy boundary between the two functions. Followers of the efficiency tradition, who appear to be fascinated by the economy of scale to be seen in the mass production industries, sometimes exhibit a tendency to apply identical reasoning to factory and farm alike, without much adaptation of logic between the two. Important differences in the progression of costs, the feasibility of various scales of operation, and the time factor of the respective production processes often are not clearly recognized. Since agricultural economics had emerged from the general field during the classical era, it was to be expected that similar analytical techniques would be carried over into the specialized branch of the parent science. Moreover, agricultural economics and farm management were for many years virtually synonymous. The preoccupation of the farm management field with analyses of the firm resulted in such neglect of interfirm relationships as to lead to the establishment of still another discipline called land economics, which is concerned chiefly with institutional problems. Each such discipline has approached the efficiency tradition in its own way, but none has shaken the grip which it holds on the American imagination.

Actually, the efficiency tradition has been strengthened by the onrush of urbanization during the last 75 years. In 1870, 75 percent of the U.S. population lived on farms. By 1945, farm population had declined to 17 percent of the total. In 1870, 53 percent of the Nation's gainfully employed workers were to be found in agriculture, a figure which had dropped by 1945 to only 15 percent. Such drastic shifts in the residential and occupational classification of population, of course, were accompanied by very great adjustments in the size of farm units as well as in operating techniques. Despite periodic fluctuations in the trend, human resources have flowed steadily in a rural-urban direction. Narrowly conceived, agricultural efficiency is a goal that is being achieved.

The Conjunction of the Traditions

No thoughtful conception of the American family farm ideal is completely free of the agrarian tradition, the democratic tradition, and the

efficiency tradition. Much as in a navigational fix, the three traditions intersect in a small triangulation which marks the American ideal. This is the relative position of any given observer, his proximity to each of the reference points being determined by the extent of his intellectual bias toward one type of traditionalism or another. Of these three figurative points, the democratic tradition may be said to engage much the greatest share of the helmsman's attention, for it is the one which marks the main channel, whose range is most familiar, and whose bearing is most nearly on course.

The agrarian tradition is the oldest, the efficiency tradition the youngest. Throughout the world the agrarian tradition is a factor of some consequence in peoples' cultures, while the democratic tradition is mainly a product of western civilization, and the efficiency tradition of the American enterprise system. The agrarian tradition is focused on the family, the efficiency tradition on the farm, the democratic tradition on the utility of the mechanism for promoting responsible citizenship. The agrarian tradition suggests an upper limit on the size of individual landholdings, the efficiency tradition a lower limit; and in the American family farm ideal, both owe their modern orientation to the democratic tradition. But how is it possible to reconcile the conflicts inherent in such traditional forms and to effect the synthesis so badly needed as a guide to public policy? Witness this attempt:

> The fundamental elements of a farm as a going concern are entrepreneurship, land (nature), capital, and labor. In its most rigid form, the family farm is one in which all these factors reside wholly within the farm family. In this sense there need be no consideration of whether the management is effective or ineffective, the land productive or unproductive, the capital adequate or inadequate, the labor underemployed or overworked. All attempts, however, to define the family farm on any such basis as this would be wholly unrealistic and could serve no useful purpose either as a device for statistical tabulation or as a goal for public policy. Certainly this is not the kind of family farm which has been the objective of land tenure policies in the United States for nearly a century . . .
>
> Our definition of a family farm consists of the following characteristics:
>
> 1. The entrepreneurial functions vested in the farm family.
>
> 2. The human effort required to operate the farm provided by the farm family with the addition of such supplementary labor as may be necessary, either for seasonal peak loads or during the developmental and transitional stages in the family itself. (The amount of such regular outside labor should not provide a total labor force in excess of that to be found in the family of "normal" size in the community.)
>
> 3. A farm large enough, in terms of land, capital, modern technology, and other resources, to employ the labor resources of the farm family efficiently. (The labor resources of a family farm are deemed to be employed efficiently when the rewards for their efforts are equal to rewards for comparable human efforts in other occupations. Rewards in this context are in real terms in contrast

to monetary rewards and include the value that members of the farm family place on leisure, working close to nature, "independence" and other nonmonetary values ascribed by them to farming.)[8]

This was truly an heroic effort to reconcile the three traditions! It embraced the agrarian tradition by inclusion of nonmonetary rewards–leisure and "working close to nature—" and by placing a ceiling on the scale of operations. It subscribed to the democratic tradition by paying its respects to the long-time public policy goal of this country,[9] by vesting the entrepreneurial functions in the farm family, and by assigning a footnote value to "independence." It was vigorously colored by the efficiency tradition, repudiating uneconomical factor combinations, proposing a firm minimum for the scale of operation (in terms of labor utilization), and endorsing the efficient application of "modern technology." This should have satisfied the most oblique point of view. But it did not.

A committee of 11 members, presumably a fair cross-sectional group of students of land tenure problems, prepared the report from which the above excerpt is taken. Two members of the committee objected so strenuously to this treatment of the family farm ideal that finally, at their request, their names were withdrawn entirely from the published statement. Four other members wrote supplementary notes dissenting in one or more particulars from the definition agreed upon by the less-than-a-bare majority. Still another member was unwilling to let pass a comment contrasting the "more efficient producers" with "farmers who are willing to accept a low standard of living"; he wrote a qualifying note for which he assumed personal responsibility. It is questionable whether any member of the committee agreed wholeheartedly with the final product, so loaded was it with compromise.

Here we see in bold outline the philosophical schism. While the arguments were somewhat involved, in general the protests against the proposed definition clearly originated with a violated sense of devotion either to the agrarian tradition or to the efficiency tradition. In the former case the use of an "efficiency standard" as the principal criterion was sharply criticized. It was claimed that the nature of the farm and family relationship, and not the financial results or the value of the product, is the true determinant of family farm status. In the latter case, it was maintained

[8] *Op. cit., Family Farm Policy,* pp. 387-389. The committee which prepared this report at the International Tenure Conference went on to state that practically all cropper operations would be excluded by this definition. Part-time and rural resident farms would have to be classified as "quasi-family"' farms. Ownership of the land was not essential, provided the other elements of the family farm were present.

[9] The reference to "nearly a century" displays a lack of historical perspective on somebody's part.

that "the concept of the family farm should include those farms where at least one half of the labor required is provided by the operator and his family."[10] In other words, the ceiling ought to be lifted a little in the interest of efficiency.

Such clashes of opinion might be dismissed as a tempest in a teapot, an exercise in semantics or as mere professorial bickering. But should they be? The concern of the conferees was genuine. If the family farm is to continue serving as one of the symbols of democratic idealism, it is entirely appropriate to ask, "What is it?" If the Jeffersonian principle of widely dispersed, firmly held rights in private property has a logical extension into all sectors of the economy, it is enormously meaningful for the future of the Nation, and it should be examined and tested by the most rigorous means available.

The need has been recognized by numerous observers. As Zimmerman puts it, "Most of the great issues facing agriculture the past 25 years have slowly but increasingly (and unknowingly) split over family policy."[11] With encouragement from many quarters, the Census Bureau has established "economic classes" of farms, a classification based upon the value of farm real estate and the level of gross farm income. Benedict and others suggested an income criterion which would place the family farm in a range between $600 and $10,000 per year (gross farm income adjusted to 1939 prices).[12] The Department of Agriculture borrowed the idea, adding a general definition of a family farm as one "on which the operator, devoting substantially full time to farming operations, with the help of other members of his family and without employing more than a moderate amount of outside labor, can make a satisfactory living and maintain the farm plant."[13] The International Conference on the Rural Church and Farm Land Tenure defined the family farm in much the same terms, with the additional proviso that the "food and fiber required by others is produced efficiently."[14] Commons took note of the political implications of the family farm ideal with his deprecating reference to "the communist trend of increasing efficiency to large-scale mass production, so that the independent farmers would be reduced to wage earners employed by

---

[10] *Op. cit., Family Farm Policy,* pp. 402-404.

[11] Carle C. Zimmerman, "The Family Farm," *Rural Sociology,* Vol. XV. No. 3, Sept., 1950, p. 216. Zimmerman's position is evident from his statement, "The important aspect of family farms is not the farm but the family," (same Journal, p. 216).

[12] M. R. Benedict *et al,* "Need for a New Classification of Farms," *this Journal,* vol. XXVI, 1944, pp. 694-708.

[13] U.S.D.A., Interbureau Committee on Postwar Agricultural Problems, "Farm Opportunities in the United States," July, 1945, p. 44.

[14] Marshall Harris and Joseph Ackerman, *Agrarian Reform and Moral Responsibility,* Agricultural Missions Inc., New York, 1949, p. 3.

agricultural corporations."[15] Goldschmidt used the term "small farm" as a synonym for family farm in his classic study of two California communities.[16] This last-named study was published after the Chicago conference had concluded: "Specific information on the relative merits of family farms and either larger or smaller units is conspicuously unavailable."[17] It went so far toward developing specific comparisons between small-farm and large-farm communities that the summary findings are worth repeating.

Community Contrasts

Goldschmidt selected two communities in California for his comparative analysis. With respect to the availability of natural resources, the status of the two communities was strikingly similar, but they differed greatly in the average size of farms in the surrounding areas. In one, the land was held in exceedingly large tracts and operated under a corporate system of management. In the other, farms were relatively small and were operated mainly by the families of owners and managing tenants. If we bear in mind that the average yearly production on "small farms" in this study was *$3,300 at 1940 prices*, the following summary findings are revealing:

1. The small-farm community supported 62 separate business establishments, to but 35 in the large-farm community; a ratio in favor of the small-farm community of nearly 2:1.
2. The volume of retail trade in the small-farm community during the 12-month period analyzed was $4,383,000, as against only $2,535,000 in the large-farm community. Retail trade in the small-farm community was greater by 61 percent.
3. The expenditure for household supplies and building equipment was over three times as great in the small-farm community as it was in the large-farm community.

The investigation disclosed other vast differences in the economic and social life of the two communities, and affords strong support for the belief that small farms provide the basis for a richer community life and a greater sum of those values for which America stands, than do industrialized farms of the usual type. It was found that—

4. The small farm supports in the local community a larger number of people per dollar volume of agricultural production than an area devoted to large-scale enterprises, a difference in its favor of about 20 percent.
5. Notwithstanding their greater numbers, people in the small-farm community have a better average standard of living than those living in the community of large-scale farms.

---

[15] John R. Commons, *The Economics of Collective Action*, The Macmillan Company, New York, 1950, p. 229. The near-parallel between this grim expectation and the outlook posed by the efficiency tradition might, upon close examination, cause some discomfort to the extremists in the efficiency camp.

[16] *Op. cit.*, "Small Business and the Community."

[17] *Op. cit.*, *Family Farm Policy*, p. 15.

6. Over one half the breadwinners in the small-farm community are independently employed businessmen, persons in white-collar employments, or farmers; in the large-farm community the proportion is less than one fifth.

7. Less than one third of the breadwinners in the small-farm community are agricultural wage laborers (characteristically landless, and with low and insecure income) while the proportion of persons in this position reaches the astonishing figure of nearly two thirds of all persons gainfully employed in the large-farm community.

8. Physical facilities for community living—paved streets, sidewalks, garbage disposal, sewage disposal, and other public services—are far greater in the small-farm community; indeed, in the industrial-farm community some of these facilities are entirely wanting.

9. Schools are more plentiful and offer broader services in the small-farm community, which is provided with four elementary schools and one high school; the large-farm community has but a single elementary school.

10. The small-farm community is provided with three parks for recreation; the large-farm community has a single playground loaned by a corporation.

11. The small-farm town has more than twice the number of organizations for civic improvement and social recreation than its large-farm counterpart.

12. Provision for public recreation centers, Boy Scout troops, and similar facilities for enriching the lives of the inhabitants is proportioned in the two communities in the same general way, favoring the small-farm community.

13. The small-farm community supports two newspapers, each with many times the news space carried in the single paper of the industrialized-farm community.

14. Churches bear the ratio 2:1 between the communities, with the greater number of churches and churchgoers in the small-farm community.

15. Facilities for making decisions on community welfare through local popular elections are available to people in the small-farm community; in the large-farm community such decisions are in the hands of officials of the county.[18]

Despite the localized nature of these findings, they come out of a study made in a state that offers a full range of the extremes—from the epitome of the agrarian tradition to the ultimate in "efficiency." It is not hard to discern from them, either, the degree to which the analysis might have been conditioned by a belief in the democratic tradition. If one of the primary goals of an effective system of land tenure is a "well-integrated community life," such a goal is apparently much more likely to be attained in the small-farm or family-farm community than in the large-farm community.[19] Thus, there seems to be some basis for the apprehension that

[18] *Op. cit.*, "Small Business and the Community," pp. 5-6.

[19] In one unusually compact listing of long-range tenure goals, seven other objectives are proposed: 1) responsible freedom of personal action, 2) equality and dignity for all tenure groups, 3) secure possession of rights in land, 4) equitable distribution of rights in property, 5) conservation and development of physical resources, 6) highly efficient utilization of productive resources, and 7) equitable distribution of income. Marshall Harris, "Caribbean Land Tenure Symposium," reprinted in *Readings on Agricultural Policy*, Blakiston, 1949, p. 379.

follows any drift away from the family farm ideal, whether it manifests itself in a mounting proportion of very large farms, or as in the 1930's, in the acquisition by loan companies of numerous farms through foreclosure.

The Cause of the Confusion

There is no question that the three traditional supports of the family farm ideal constitute an imperfect mixture. Yet distillation of the arguments over the family farm in this country leaves a fairly substantial residue of common purpose, namely, *the objective of full and equal opportunity for social and economic advancement by all members of rural American society.* The family farm, as one important means to this end, must have certain qualities in order to be most useful. A consolidation of those qualities upon which there is general agreement is possible, although it is somewhat easier to identify them in negative terms. Simply as a basis for discussion, permit me to itemize what a family farm *should not be.* The family farm:

1. Should not necessarily be restricted to those farms operated under full ownership.
2. Should not be so limited in resources as to prohibit satisfactory living conditions for the family.
3. Should not involve resources so extensive as to result in a distinct separation between labor and management.
4. Should not be complicated by tenure arrangements so lacking in security of expectation as to inhibit the social and economic development of the operator and his family or the physical development of the farm.

Two premises underlie these crude markings of the metes and bounds of the family farm ideal. The first is that a zone is adequate for marking the path of a generalized guide for group behavior. The second explains the negative phrasing, and that is the premise that it is equally as important to know what a family farm *is not* as to know what a family farm *is.* The latter premise is particularly relevant to a democratic system in which group action, more often than not, takes the form of avoiding that which is undesirable, rather than of making a concerted move toward a desired goal.

Most of the turmoil over the family farm concerns a problem of measurement rather than of substantive meaning. This misplaced emphasis upon precise measurement has been aggravated by reliance upon, and widespread misuse of, data from the U.S. Censuses of Agriculture. Too often the careless use of census data has led to the conclusion that the family farm is in process of destruction, either from the growing concentration of holdings in a few hands or from the parcellation of farms into units of exceedingly small size, or both. Griswold challenges this con-

clusion, stating that, "Rich or poor, productive or unproductive, the overwhelming majority of American farms continued (in 1945) to be operated as family ventures."[20]

The most common blunders in the use of census data result from the user's failing to differentiate between regional trends and aggregates for the United States, from ignoring clear explanations of changes in enumeration methods from one census to the next, or from the fatal fascination of such oddities as the plantation (which never accounted for more than 18 percent of the total farms even of the South). Between 1940 and 1945, for example, a marked rise occurred in the number of farms of 1,000 acres and over, but most of the increases occurred in the Western States and were due almost solely to revised methods of enumeration. Most regions showed only small gains, and New England a loss, in the average acreage in farms between the two censuses. Farms in representative Midwestern States such as Ohio and Illinois were actually smaller in 1945 than in 1860.

These data, of course, do not allow for the tremendous strides in technology from one census to the next. For that matter, census data reveal very little information that is pertinent to the criteria reviewed on the preceding pages. They tell us nothing as to where the burden of entrepreneurship falls, or of the efficiency of operation, and certainly nothing about "nonmonetary rewards." In the South especially, the census does not even indicate the number of operating units. Yet the census is frequently cited in support of the thesis that the family farm is a vanishing species and must be saved through some immediate, large-scale, and uncertain action.

Again, for an explanation we can only turn to the preoccupation of social scientists with static analysis. If striving toward the family farm ideal can be viewed as a general course which is acceptable to the vast majority of Americans, then the problem of definitions can be subordinated to the problem of dynamic relationships. The absolutes of farm size, income, tenure, or efficiency are without meaning until they are converted into relatives; and the relatives of census aggregates, while helpful, cannot be relied upon wholly to furnish meaningful answers. A sizable increase in very large farms or in very small farms is a warning of a drift toward something the country has demonstrated it does not want. Unless, however, there is some knowledge as to how this or that farm and family relationship has changed or dissolved through time, the basis for remedial measures is likely to be faulty.

Moreover, the shortcomings of static analysis do not negate the fact that measurement of change implies the standardization of criteria of the family farm as it exists at some given moment of time. If anything, the challenge to bring the family farm concept within quantitative limits is

[20] *Op. cit.*, *Farming and Democracy*, p. 134.

more urgent today than ever before. By turning their best efforts and talents to this task, rural social scientists conceivably may contribute now to policy-making decisions in a most significant way. A possible approach to the needed research can only be suggested here.

Upper and Lower Limits

Quantitative limits call for a range of farm types and sizes that will be meaningful throughout all or most of the United States. To put it another way, minimum and maximum levels should be converted to some measurable standard. The establishment of "economic classes" is a thoughtful step in this direction, but the disadvantages of economic classes are several, not the least of which is their dependence upon census data. Items two and three in the preceding list of characteristics lying outside of the family farm concept are suggestive of means by which refinements may be applied to minimum and maximum resource levels.

How are "satisfactory living conditions for the family" to be determined? Engel's laws, especially the first and fourth, are indicative of one point of departure for the analysis. These laws tell us: "As the income of a family increased, a smaller percentage was expended for food; and as the income increased in amount, a constantly increasing percentage was expended for education, health, recreation, amusement, etc."[21] With respect to living conditions, there can be no serious disagreement among students of the problem as to what is acceptable as an *absolute* minimum —for example, in the matter of housing and related facilities, a roof that does not leak, windows that are screened and a water supply that is safe to use. These things are measurable, just as the distribution of income and its bearing upon living conditions are measurable.

Whether approached through studies of family budgeting or through such devices as socio-economic status scales, "satisfactory living conditions" may be reduced to quantitative terms. The literature in both areas is sufficient as a start toward identifying a bottom limit for the family farm. How much above the irreducible minimum our public policy sights may be raised would still constitute a quarrelsome potential for the agrarian-versus-efficiency traditionalists, but at least through such a procedure the debate might be drained of some of its emotionalism. It should have the salutary effect, too, of forcing extremists to view the end product of their beliefs in the light of tangibles. No exponent of extreme agrarianism will confess to advocating rural poverty, but if confronted with the

[21] See Carl C. Taylor, *Rural Sociology*, Harper & Brothers, 1933, pp. 173-176. Of the first and fourth laws, Taylor comments that their "validity . . . for the average distribution of family incomes under the economic pressure of low incomes has been substantiated in every standard of living study made since Engel's, irrespective of whether the study was of urban or rural family budgets." (p. 174)

specifics of slum housing, poor diets, and inadequate education, his position rapidly becomes untenable. No believer in the boundless potentialities of technical efficiency openly recognizes the problems created by excessive concentration of holdings, until he is confronted with concrete evidence of the consequences, perhaps along the lines pursued by Goldschmidt.

A ceiling for the family farm poses fewer difficulties of measurement, although the precise point at which the break between labor and management occurs is never clear in marginal cases. In some types of production requiring extremely high labor inputs for short periods (notably in certain specialty crops), the distribution of labor and management is not always applicable as a guide. A citrus grove, for instance, for which the major portion of the labor requirements could be met by the family, would fall below the optimum size by any reasonable standard, unless it were part of a combination of enterprises.

In the vast majority of cases, however, "a family farm ceases to be a family farm when the cost of hired labor becomes a critical factor in the success or failure of the business."[22] Following this criterion, many large-scale production units, e.g., cotton plantations, would automatically be eliminated from the family-farm category. Intensive local studies, astutely conducted, would still be needed as a basis for classifying other units. Much of the background data already have been collected on various farm management studies, but these rarely have been oriented to a specific family-farm analysis.

These jobs—the conversion of generalized criteria of the family farm into measurable limits—are neither new to agricultural economists nor wholly neglected by them. But the times have brought added significance to an old problem, and the purposeful application of tools now available can bring it closer than ever to a solution.

---

[22] The author of this succinct observation remains unknown to this writer, despite a careful search of the literature on tenure. The statement was quoted by the late Leonard A. Salter at the International Land Tenure Conference held in Chicago in 1946, but it did not appear in the published material from that conference.

PROBLEMS IN WOOL MARKETING RESEARCH

P. L. Slagsvold
Production and Marketing Administration

Introduction

WOOL marketing as practiced in this country up to about 1947 had undergone relatively few changes since commercial sheep production began. Clips or lots of wool were sold entirely on the basis of guesswork as to quality and value, generally termed "visual estimates." The estimates covered clean content—which accounts for approximately 50 percent of the value; and fineness, staple length, variability, color, soundness and other physical characteristics of wool fibers—which account for the balance.

Wool, as it comes from the sheep, contains various nonwool components, such as grease, dirt and sand, various vegetable matter and moisture. The percentage of these impurities in any one fleece may range from as low as 25 percent to as much as 75 percent, depending upon the conditions under which the wool is grown, its fineness and length of staple, weather conditions, and various other factors. Generally, the finer and shorter the wool, the greater the proportions of impurities. In the manufacturing process, the raw wools used for making yarn and fabrics first are scoured and most of the impurities are removed. On the average, the washed product will contain about 14 percent nonwool components. Consequently, the value of the grease wool necessarily depends to a considerable extent upon the quantity of usable cleaned wool which it contains, or upon "shrinkage," as it is commonly known.

Present Status of Wool Marketing

Beginning in 1947, the core test analysis technique for shrinkage determination had been perfected to the point where the clean wool content of clips or lots could be determined objectively, with the use of coring equipment to draw representative samples and certain laboratory techniques to test the samples for impurities and moisture. In that year, all wools acquired by the Commodity Credit Corporation under the government price support program were core tested for shrinkage determination. In other words, it then became possible to eliminate about one half of the guesswork involved in determining value of clips or lots of grease wool. The Livestock Branch has conducted further research to refine and simplify core sampling and testing procedures to increase accuracy, but shrinkage determination by core test is now accepted by wool growers and the trade without question.

So far as the other factors which determine value and utility of grease wools are concerned, visual estimates still are used. This applies to determination of fiber diameter, or fineness, the variability within fleeces and lots, staple length, soundness, color, and other factors. The experts can classify grease wools on the basis of fineness, but upon occasion even their estimates prove to be in error. Staple length is relatively easy to determine, by hand sampling and use of a ruler. However, the measuring is not entirely standardized, some using the stretched and some the unstretched fibers in classifying grease wool for length. Soundness can be determined by a simple test of the strength of representative staples and color by scouring small samples. Crimp (the undulations in the fiber), another quality factor, can be measured objectively, but as yet there are no standard methods or any clear-cut interpretation of its significance in value and utility.

As a consequence, wool necessarily has been sold by producers entirely on the basis of inspection and visual estimates of value. And the information and bargaining power have been largely on the side of the buyer. Not only do buyers start with more knowledge of wool quality, but after a clip has been processed, information became available to them as to shrinkage and the various quality factors, for use in another year. The producers generally do not have the advantage of this same background and knowledge of wool to permit bargaining equality. They have some ideas of relative values based upon experience in previous years, but at best these largely form the basis for guesses only.

Even experienced buyers cannot be expected always to appraise wool accurately by visual estimates. Moreover, since the question of personal loss is involved in the evaluation, they necessarily must estimate so as to be on the safe side both with respect to clean content and quality. In order to "average out," some clips must be bought with a good safety margin, to compensate for any possible overestimates of the value of other clips. Consequently, wool marketing has been too much a matter of guesswork and uncertainty, for many buyers as well as for producers.

Present Marketing Guides

Some marketing guides, of course, are available at the present time. For example, a set of six grades of "wool market classes" recently was developed by the U.S. Department of Agriculture as a basis for broad classing of fleeces as they come from the sheep. A set of 12 wool grades were promulgated several years ago to serve as guides for the breakdown of individual fleeces and clips into uniform lots, called matchings, prior to processing. However, these grades are entirely visual and are based only upon one quality factor, namely, fineness. Specifications covering other important characteristics of the wool fiber are not available, but are in process

of development, as for example, staple length. Length now is a matter of market terminology and interpretation, without uniformity in application. In some cases, the fibers may be stretched to straighten out the crimp when length is to be determined, and in others the natural length is used in the classing. In either procedure, the specifications are on a visual basis, the thumb—which is said to average two inches in length—being used as the yardstick. Quantitative specifications for both fineness and length now are being developed by the Department of Agriculture.

Sampling and rapid testing techniques for determining the various quality factors also are being developed. For example, the Department recently has perfected a tool for use in sampling bags and bales of wool for staple length determination. Also developed is a tool to draw samples for fiber fineness and variability analyses, although the cores drawn for clean content analysis also are used for this purpose. So far as testing is concerned, new procedures have speeded up the work very materially, as well as increased the accuracy of results.

However, despite what has been done on wool standards and grades by the Department of Agriculture and others, there still is a lack of well defined, objective specifications for all of the various quality factors, as well as an absence of adequate objectives and proven methods of sampling and testing.

The presumably best informed people in the wool industry have maintained that wool is a highly variable product; hence it does not lend itself to accurate defining, grading, or classing, and to sale on the basis of description. The same attitude initially was taken toward the establishment of grades, classifications, and testing for several of the other farm commodities which now are sold almost entirely on the basis of description. Since wool is more variable than most other farm products, it only means that the tasks of developing proper specifications and quality classes, as well as objective sampling and testing procedures, may be relatively more difficult. Given time and with cooperative effort by research agencies, wool growers, trade and industry, the problems will be solved.

Bases for Improvements in Wool Marketing

In considering wool marketing improvements and wool marketing research, two general alternatives are possible, namely, (a) improvements in present methods and (b) development of new methods. To date, most of the research, as well as the discussions and proposals, has dealt with improvements in the present system, and much less thought and effort have been devoted to the possibility of introducing entirely new methods of marketing.

It is axiomatic that wool marketing methods as now carried on, with

perhaps some more or less worth-while improvements, must remain roughly as they are so long as quality and value of the product sold remain subject to estimates and guesswork. Consequently, introduction of new methods of marketing is possible only (a) if understandable, reasonably precise, workable, and acceptable classifications and specifications are developed for the various quality characteristics of the product; and (b) if objective methods of sampling and testing of lots can be perfected to permit speedy, accurate, and economical determinations. Until these conditions are fulfilled, wool marketing will continue as in the past, with such improvements as experience and research can accomplish.

Importance of Wool Shrinkage Determination

As already noted, one half of the problem of value determination has been solved through adoption of the core testing technique to measure shrinkage of the grease wool. However, this development, which in itself is a very significant basis for improvement, generally has had little influence on traditional methods of wool marketing. It can and has eliminated some of the disadvantages handicapping growers in selling clips, but to date the techniques have been relatively expensive, primarily due to the cost of travel involved in drawing the samples. Moreover, many producers do not have electricity available for the motor used in coring. Consequently, altogether too few wool growers have found it expedient to core test on the ranch or farm prior to sale, or to sell on the basis of clean content.[1]

A great deal of coring for shrinkage analysis currently is done in warehouses and mills, both on domestic and foreign wools. Much of this testing, however, comes after the wool has passed out of the hands of producers. At least two commercial firms maintain a core testing service, but little of the work involves growers' clips on ranches at the present time. One or more of the experiment stations in the West also has entered the core testing field, and indications are that a considerable number of wool producers avail themselves of this service, when it is furnished essentially free of charge or at a very nominal cost.

In this connection, it might be pointed out that, when wool is selling for $2.00 per clean pound, an estimated shrinkage of 50 percent means $1.00 per grease pound. If the estimated shrinkage is 55 percent, the price

[1] The Department of Agriculture is experimenting with a simple procedure whereby growers can draw their own samples by use of a pressure coring tube—which does not require electric power—and test for shrinkage on the ranch. The tube is approximately ⅝" diameter and is inserted into bags or bales by hand pressure. Results to date indicate that while home testing of the samples drawn may not yield completely accurate results, they should be sufficiently correct to give considerable protection to the seller who is not in position to have his clip core sampled and tested in the laboratory.

per grease pound would be $0.90, or 10 cents per pound less. Hence, it is of great importance to growers to make use of objective methods of determining the shrinkage of their clips, in order to realize as nearly as possible the full market value. Wool generally has been and is sold on the basis of a flat price per grease pound, which places producers at a considerable disadvantage, since in most cases they do not have the necessary experience to make reasonably accurate shrinkage estimates and, usually, they cannot compete with experienced buyers in this respect.

Suggested Emphasis in Wool Marketing Research

The major problem remaining, in so far as evaluation of clips or lots of wool is concerned, is the development of specifications and sampling and testing procedures which will give an objectively accurate, speedy, and economical answer to the question of fineness, variability, staple length, and whatever other physical—and measurable—characteristics influence value and utility. If and when these procedures are developed, trading in wool can be done on the basis of description, with market prices reflecting quality and variations with reasonable accuracy. An entirely new field of wool marketing research then would be opened up, especially with reference to the following problems:

1. Feasibility to growers and others of selling wool clips or lots on the basis of description. Specific projects might include determination of (a) best methods and procedures for selling, buying, and inspections; (b) returns as compared with selling on the basis of inspection and estimates of shrinkage and quality; (c) changes necessary in marketing methods to give producers full benefit of new developments; (d) relationship to futures trading and hedging; (e) effect on pricing and price differentials; (f) marketing costs and margins; and (g) influence on mill buying practices and adjustments to meet requirements in terms of the various fiber attributes.

2. Effect of new developments on present market organization for wool. Problems to be dealt with concern especially (a) operations of cooperatives, with reference especially to methods of handling clips and allocating proceeds from sales and including also establishment and operations of wool pools for small producers; (b) changes in preparation and packaging practices necessary to correlate with changes in methods of marketing; (c) effects on local and central market operations and relationships; and (d) efficiency of marketing system relative to services performed.

3. Development of workable and acceptable grades and classifications for varying qualities of grease wool, based upon and correlated with the degree of accuracy possible in the sampling and testing procedures. The necessary norms and variations in wool from different breeds and for

different classes may need to be determined, as well as the relationships of quality factors in grease wool to those in the products resulting from the processing. Fleeces generally contain a fairly wide range of fiber diameter, but there is a relatively narrower range of fineness and staple length within which the majority of the fibers fall. Hence, before workable grades can be established as a basis for sampling and testing lots of grease wool and selling on description, the normal bulk content and variability of specific classes must be established.

There are many other problems to solve, especially with respect to methods and procedures, inspection requirements and services, and with regard to buying and collection of import duties. However, research programs dealing with these questions can be determined only as the impacts of new methods and techniques make themselves felt in the performance of the various marketing functions.

Studies in Improvement of Present Marketing Methods

Research designed to improve present marketing methods falls into three general categories, that is, (1) economic, (2) technological or physical, and (3) a combination of the two. The purely economic problems cover primarily marketing costs and margins, relationships between marketing methods, market organization, and wool prices; price relationship between grades and qualities, then, place and method of sale; and market news and reporting. On the technological problems, the ones of major importance cover development of grades and standards; determination of clean wool content, fineness, staple length and other quality characteristics in clips; and methods of improved preparation and packaging. Such problems as processing all or part of a clip prior to sale, and pooling and sale of clips, are combination economic and technical.

A review of present and traditional wool marketing operations shows that the following factors probably are of greatest importance in determining returns to growers in any given market and price situation and, therefore, the ones which might receive major consideration in research leading to improvements in present practices:

1. *Method of Preparation and Packaging.* Some clips are said to be "original bag," while others presumably require grading. It seems evident that mixed clips generally should be graded, since buyers must protect themselves against misjudgment by overestimating shrinkage and underestimating the quantity of the best and most valuable grades in the clip. However, even so-called uniform clips may bring greater returns if graded on the basis of staple length.

In some of the countries exporting wool to the United States, not only are the clips graded, but essentially also sorted. This applies, for example,

to Australia and South Africa, where wool production is relatively more important from an over-all agricultural standpoint than it is in this country. As a result of this additional preparation, the cost of processing foreign wool is considerably less than for domestic wools. However, there are no factual data showing the economic advantages, or disadvantages, of following the same practices here. Conditions and circumstances are different than those in Australia and South Africa, and marketing practices must be geared accordingly. Any new developments in sampling and testing for various quality factors in grease wool, as well as any changes in processing operations and in manufacturers' requirements, will have a bearing upon the needs for and the type of clip preparation which is expedient and, hence, on the type of research needed.

Experimental work has been done to test the general feasibility of ranch grading from the standpoint of present market acceptability, and the results generally have been favorable. However, in most cases the lack of sampling and testing procedures for objective determination of quality factors has precluded realistic experiments and accurate statistical analyses, or has clouded the results.

So far as packaging is concerned, the importance and economy of heavy versus light bags, jute contamination, type of bagging material most suitable from an over-all standpoint, and use of bales instead of bags are problems which might be studied in the future. If all quality factors were known, grease wools probably could be shipped in bales rather than in bags, thus probably effectuating some reduction in marketing costs.

2. *Method of Sale.* Wool growers have several choices, among them contracting prior to shearing, sale to a local buyer after shearing, sale through a cooperative, consignment to a local warehouse or to an eastern broker, or sale directly to a manufacturer. In the absence of techniques and procedures for determining quality of each clip, there are no exact measures available to determine the relative merits of any one method, nor is it entirely possible to determine if and when any one grower obtains full market value for his wool. When grease wool can be sold on the basis of description, studies can determine the best method of sale for any given area or situation.

3. *Marketing Costs.* It clearly is of material importance to wool growers that the marketing charges be as low as is consistent with adequacy of services. These costs often are obscured, especially when growers contract their clips prior to shearing. It is obvious, however, that marketing costs and margins are covered in the buyer's price, although the exact amount is not known. Data should be made available to show what the deductions are for the various methods of sale as a basis for determining relative advantages of one or another plan.

Specific problems which should be studied, regardless of any changes in basic marketing methods which may take place, are:

1. Feasibility and practicability of separating tags and off-sorts prior to sale and determination of best method of marketing these portions, with special reference to assembling, pooling, processing, and disposition.

2. Economy of separating short wools from clips and marketing them in scoured state, with reference to potential quantities and pooling; cost of assembling and processing; relative advantages or disadvantages of local scouring; freight costs; and best method of sale.

3. Marketing costs and margins, with special reference to transportation; storage, both local and central market; and handling charges as related to services rendered.

4. Relationship of mill requirements to preparation potentials on ranches and in interior warehouse, with reference to branding paint problems; separation of tags, off-sorts and short wools; and grading clips of uniform fineness for length of staple.

5. Price and value differentials for various classes of fineness and staple length in grease wools; discounts and premiums paid in relation to actual quality factors and value; and seasonal price variations for known wool classifications.

6. Relationship of futures trading to growers' wool marketing problems, especially from the standpoint of hedging wool clips prior to shearing, sale, or processing into top.

7. Improvements in and better adaptation of wool grades and standards to growers' marketing problems and to the needs of trade and industry, with special reference to market news reporting, clip preparation on ranches and in interior warehouse, and wool processing experiments.

8. Development of practical and economical sampling and testing procedures for use by growers who contract their clips, in order to determine wool quality and approximate value prior to shearing.

Current Marketing Research in PMA

Within the framework of the broad objectives of wool research outlined, the Wool Division of the Livestock Branch, PMA, is directing its current research in wool marketing toward the following specific objectives:

1. Development of sampling and testing procedures for determining the various quality factors in wool, with special reference to fineness and variability, and staple length and variability. This study is, in part, the principal foundation for any major improvement in wool marketing methods.

2. Determining relationships of fineness, variability, and staple length in grease wool to resultant card sliver and top. This study is intended to help determine the value of objectively tested lots of grease wool by

establishing the type of products which will result from processing given qualities, the thesis being that the resultant products carry more accurately defined specifications and, therefore, are more readily evaluated in the market and within relatively narrower ranges than has been the case for grease wool.

3. Development of more accurate and speedy techniques for measuring various quality factors in wool, to use as a basis for evaluating clips or lots. This is a more or less continuing activity, intended to lower testing costs and speed up results.

4. Analysis of present official specifications for wool top, with the objective of bringing about the revisions necessary to conform to present market demands in the fabrics field, changes in processing techniques and shifts in fiber competition and uses; development of quantitative specifications for those grades of top not now covered in the promulgation; and development of quantitative specifications for the various grades of grease wool matchings.

5. Also making further refinements in core sampling and laboratory procedures to increase the accuracy of shrinkage determinations.

6. Studies of improvements in preparation of wool clips at ranches and in interior warehouses, as a means of determining best methods of marketing by growers. This study includes grading work, some processing of small lots of grease wool into top, and marketing tags and off-sorts in a scoured state. The field experiments this year cover also sampling and testing of clips, in order to develop procedures for use in marketing wool on the basis of description.

7. Field tests to establish durability and scourability of a scourable branding paint which recently has been developed by the Wool Division. This fluid is proving entirely satisfactory, and its use will solve an irritating problem for wool processors, who have to expend considerable time and money to eliminate brands made by ordinary paints or tar.

Conclusions

Major efforts in wool marketing research should be directed, first, toward specific definitions and classifications of the various fiber characteristics which determine wool utility and value; and, second, toward development of objective methods of sampling and testing clips and lots of wool for the different attributes. When these objectives are achieved, much of the guesswork now involved in wool marketing will be eliminated. Also, if the differential market values of the various qualities can be reflected back to growers, it is reasonable to anticipate that better production will be stimulated. It might be expected, too, that more efficient marketing will result, although the precise effects cannot be measured

until the potential modifications in methods are determined. Cost of the buying function may be reduced in so far as acquisition of the wool clip in producing areas is concerned, since less time, travel, and personnel would be required if the seller can offer specific qualities and quantities of clean wool by mail or telephone. On the other hand, sampling and testing costs will be added to the producer's outlay.

Sounder distribution and utilization of the domestic clip might result if each manufacturer had the opportunity of purchasing specified qualities of the product. The present disadvantages of most producers in sale of their wool should be eliminated to a large extent, either through better knowledge of quality and market value if they sell direct, or through elimination of most of the objections many growers now have to pooling and cooperative marketing. Even the small producers ultimately will gain through pooling and selling on the basis of quality.

In the meantime, research dealing with improvements in present marketing practices is not wasted, since it will provide basic and background data, as well as experience, in dealing with problems involved in developing techniques and procedures for marketing wool on the basis of description.

Any wool marketing research program dealing with development of new methods, however, must be correlated with progress in processing technology, shifts in fiber uses, new fiber developments and, above all, the increase in knowledge about the wool fiber characteristics themselves. The program also needs to take cognizance of and be geared to the scope and extent of the problems involved. The underlying need for improvements in wool marketing is of national and not localized nature. Moreover, the research involved in developing the necessary facts, techniques and procedures is most likely to be successful if undertaken jointly by fiber technologists and agricultural economists, and in cooperation with wool growers, the trade, and the wool industry.

NOTES

FARM PRICE GYRATIONS BY COCHRANE*

FIRST in an article, "Farm Price Gyrations—An Aggregative Hypothesis," *this Journal*, May, 1947, and then substantially elaborated in *An Analysis of Farm Price Behavior*, Agricultural Experiment Station, Pennsylvania State College Progress Report 50, May, 1951, Professor Willard W. Cochrane endeavors to explain the instability of farm prices in the United States.

Professor Cochrane's explanation may be summarized as follows: (1) The demand for food has a low price elasticity (−.41); (2) the "output" of food by farmers has no price elasticity whatsoever; (3) the demand for food shifts about in a restless fashion because of rises and falls in per capita disposable income; and (4), whenever the demand for food makes a pronounced shift to the right, the output of food by farmers suddenly jumps ahead as farmers quickly absorb and exhaust the new and better technology that has accumulated (the period 1937–1943 is, however, an apparent exception); but when the demand shifts to the left, the output is completely inflexible. The big jumps in productivity, according to Professor Cochrane, page 30 of the 1951 report, came in 1918 with an eight-point rise; in 1923, up three points; in 1937, up 12 points; and in 1944, up 11 points. From 1937 to 1943, however, this productivity rose from 106 to 133. (A jump of 12 points in 1942 is hidden in this period.)

In the 1951 report, in the final section, "The Parts in Relation to the Whole," pages 38 and 39, Professor Cochrane says in part, "As the disposable incomes of consumers increase and decrease, the aggregate demand function for food expands and contracts. And because of the extreme inelasticity of the function, assuming no change in quantity, a small increase or decrease in demand forces a large rise in price, and vice versa." Going on to the supply, we are told, "For any given period, the aggregate output of food is constant, fixed, and sustained. In economic terms, the aggregate output function is perfectly inelastic, the total output of food changes not one bit as the index of responsible prices increases or decreases. . . . The aggregate output function takes up a new position each time worker productivity changes significantly." Professor Cochrane then asks: "What causes this perfectly inelastic output function to shift to the right or to expand?" Earlier in the report, page 33, this answer is given: ". . . it is the movement of the demand which is causal . . . (and the shift occurs when) a pool of unused technologies and 'know-how' exists. . . ."

The main difficulty with the analysis advanced by Professor Cochrane is

* I have benefited from suggestions made by my colleague, D. Gale Johnson.

that it explains too much with too little. Neither the data nor the method are sufficient to determine all of the following: the elasticities of the demand and of the supply, the magnitude of the shifts in each of the two schedules; and the impulse, timing, and termination of each particular shift. It is asking too much of accepted theory and of available data, even if both were pressed to their respective limits, which Professor Cochrane did not attempt to do.

More specifically, the particular demand analysis set forth by Professor Cochrane makes the rises and falls in disposable per capita income, in current dollars, carry altogether too great a burden in accounting for the shifts in demand that occurred from 1922 to 1948. The demand effects of changes in the personal distribution of income are neglected; changes in the composition of the population are left aside; income is represented by current dollars and not in real terms, and no account is taken of the shortcomings and difficulties in the concept of food as it is represented by the BAE index of food consumption. The price elasticity that emerges from Professor Cochrane's calculations for 1921-41, 1930-42 and for 1946-48 (leaving out 1943-45) is −.41, which is appreciably higher than that obtained in other more complete studies when using the BAE index as a measure of food consumption. (Girschick and Haavelmo study, 1922-1941, −.25; and Tobin, 1913-41, −.28). Even so, the results from the demand side appear relevant, if not precise, because a large part of the particular shifts in per capita demand for food are ascribable to changes in disposable income although changes in distribution of income and in the divergencies between dollar and real income are neglected.

The supply and output analysis is, however, much more shaky. It rests on a set of beliefs which are highly questionable on both theoretical and empirical grounds. The idea, in which Professor Cochrane persists, that agriculture is a water-tight compartment in relation to the rest of the economy, with no transfer of resources into or out of farming, is fundamentally false. The notion that agricultural inputs are completely inelastic against price is also not valid. The concept of "output per worker" in agriculture is not a meaningful measure of changes in output or of the supply of food in either a short or long run context. Nor have the adoptions of new and better technologies, so it would appear, come in big jumps.

Although some factor markets work imperfectly and slowly, they do transfer resources into and out of farming. Total production inputs in agriculture rose at least 10 percent from 1912 to 1950.[1] Fertilizer and lime,

[1] At 1946–48 factor costs. At 1910–14 factor costs, the rise in inputs is about 30 percent. The 10 percent may be taken as the lower limit, and the 30 percent as the upper limit in the increase in aggregate inputs from 1912 to 1950.

nearly all of which come from the rest of the economy, were up threefold; inputs used to operate motor vehicles, also from the nonfarm compartment, were over 90 times as large in 1950 as in 1912; inputs employed to maintain (or taken as depreciation) buildings, motor vehicles, machinery and equipment were up about 80 percent, as were some other inputs acquired from other sectors of the economy. Meanwhile, total farm labor inputs,[2] despite the substantial net reproduction rate of the farm population, were down about 30 percent in 1950 compared to 1912, as a result of transfers of this class of inputs out of farming. These and other changes in agricultural inputs are not compatible with the convenient, "water-tight compartment" thesis, so frequently ascribed to agriculture.

Professor Cochrane's belief that the output of food by farmers "is perfectly inelastic" does not square with either his data or with better data on total agricultural inputs. Moreover, if the data were to show zero elasticity on this score, it would be most difficult to find a rationale to raise them above suspicion. Let us take, first, some periods when farm product prices turned favorable, setting the stage for an expansion in agricultural inputs. Such a period was 1917 to 1920, with 1920 committed inputs planned largely on 1919 prices; and total inputs committed to farming in the United States rose eight percent. The years 1925 to 1929 show up as another expansion period in inputs. The turn in prices that came with World War II induced farmers to expand total inputs about seven percent from 1939 to 1950, and this expansion represented diverse adjustments among the various inputs. Even these crude data leave little doubt that inputs committed to farming are responsive to prices, and that changes in technology are not the only variable affecting (increasing) agricultural production.

But do farmers contract when farm product prices fall relatively? Not one bit, is Cochrane's thesis, a view quite widely held. Input data, however, do not support this view, although the elasticity is very low. Total agricultural inputs were reduced about four percent from 1920 to 1924, a period that was adverse for agriculture. From 1930 to 1933 the contraction in agricultural inputs was about six percent, with an additional sharp drop, about five percent, in 1934, which was largely unplanned because of the widespread drought of that year. Let me call attention to one class of inputs, fertilizer and lime: about 30 percent less was used in 1921 than in 1920; and 45 percent less in 1932 than in 1930. Why then did Professor Cochrane find no elasticity in "output" against price? Among others, two reasons may be indicated: (1) The index of agricultural production which he used hides some of these adjustments. Gross farm production

[2] We shall stress the inaccuracy of farm employment data. The farm employment data of the BAE understate the decline in labor inputs, as we shall indicate below. We have modified the BAE data to reflect the changes shown by the Bureau of Census.

would have been better, but it also is the result of inputs and yields. A much better measure is to be found in agricultural input data, and more particularly *planned* inputs by farmers. (2) The particular grouping of years on which Professor Cochrane hit tends to hide even those expansions and contractions which are evident in the data that he used.

On page 33 the report says, ". . . it is the unique constancy of employment in agriculture which produces a perfectly inelastic curve." Only the period 1949 and after is cited as an exception. If the quantity of a particular input remains perfectly constant and if the total output is also constant, then, of course, it does not matter whether the input is important (as is labor) or very unimportant, the ratio between this input and total output will remain unchanged. We have already shown that planned outputs, as indicated by planned inputs, did not remain unchanged. Before considering the data on "workers" in agriculture, it should be noted that Professor Cochrane contends that when the "output per worker increases, the output curve shifted to the right" (page 31) and that these shifts have come in jumps in 1918, 1923, 1937, and in 1944, and that each jump is wholly the result of new and better technologies, and not even in part the consequence of more nonlabor inputs.

Two comments now on data on workers in agriculture: (1) Existing information on this variable is far from accurate, as Johnson and Nottenburg have shown;[3] and (2) the data that are at hand do not indicate "unique constancy." Total farm labor inputs rose five percent from 1912 to 1920, and by 1950 had been reduced about 33 percent from the 1920 level.[4]

Finally, a word on Professor Cochrane's jumps in productivity, which he ascribes to sudden spurts in the adoption of new and better technologies by farmers. Explanations aside, what about the data? First, it is necessary to consider all inputs and relate these to total output and not only one class of inputs; and second, the 1935-39 weights are inappropriate in considering what happens after the middle forties because they hide the substantial substitution of capital for labor that occurred as a result of changes in the relative prices of these inputs.[5] In general, the picture that emerges is as follows: (1) the ratio of total agricultural inputs to total farm outputs fluctuates but shows no trend from 1910 to about 1922; and (2) the trend of the ratio of outputs to inputs increases significantly from about 1922 to 1950, again fluctuating from year to year mainly because of variations in yield, but with no discernible change in the upward trend, as the following data indicate:

---

[3] D. Gale Johnson and Marilyn Corn Nottenburg, "A Critical Analysis of Farm Employment Estimates," *Journal of American Statistical Association*, Vol. 46, June, 1951.

[4] Inputs based on 1946-48 factor costs, reflecting changes in the farm-labor force indicated by Bureau of Census data.

[5] It was for this reason that the writer suggested that the BAE recalculate the Barton-Cooper data on farm inputs, weighting them by 1946-48 factor costs.

INCREASE IN THE RATIO OF FARM OUTPUTS TO INPUTS, UNITED STATES, 1910–48[a]

Year	Farm output per unit of input	Year	Farm output per unit of input
	1910–14 = 100		1910–14 = 100
1910	100	1930	106
1911	98	1931	117
1912	106	1932	117
1913	95	1933	111
1914	101	1934	99
1915	102	1935	119
1916	96	1936	105
1917	104	1937	130
1918	101	1938	125
1919	99	1939	126
1920	102	1940	130
1921	92	1941	138
1922	102	1942	152
1923	104	1943	147
1924	106	1944	151
1925	108	1945	149
1926	111	1946	153
1927	108	1947	146
1928	112	1948	158
1929	111	1949	153
		1950	153

Source: Division of Farm Management and Costs, BAE, January 8, 1951.
[a] Inputs weighted by 1946–48 prices.

It is my belief that the instability characterizing farm prices may be explained by a very simple hypothesis; namely, that the price elasticities of the demand and of the supply of farm products are relatively low, and that the shifts in at least one of these schedules are substantial. Data for the United States, for the period under consideration, appear to indicate that the elasticities of the relevant schedules have been relatively low. (However, the elasticity of the supply schedule has not been zero, whether one takes the long run, the short run, or even the stock period, the period during which the stock is given.) The data also appear to indicate substantial shifts in the demand. But the supply of farm products has not jumped, when we leave aside the effects of year-to-year variations in yield while gauging the supply effects of changes in aggregate inputs and advances in production techniques; on the contrary, the shifts in the supply in the short run have typically been small.

THEODORE W. SCHULTZ

University of Chicago

A REJOINDER

IT IS interesting to observe that Professor Schultz reaches a conclusion in the final paragraph of his note which is similar to if not identical with mine. Only the degree of inelasticity of the aggregate supply function seems to separate us—a difference which I consider insignificant, and which does not lend itself to unqualified resolution, given the present state of knowledge. I agree that an analysis of aggregate output in terms of total inputs should prove fruitful, but that analysis does not emerge in the Schultz note. And we should recognize that if Professor Schultz does establish the fact that total inputs in agriculture are highly variable, then the concluding hypothesis of the Schultz note, as well as my own analysis, is blown out of the water.

WILLARD W. COCHRANE

University of Minnesota

AGRICULTURAL OUTPUT AND INVESTMENT IN POSTWAR EUROPE*

THE most striking feature of Europe's postwar agricultural development is the comparatively rapid recovery of farm production. Recovery came faster than it did following World War I, in spite of the much heavier destruction and disorganization during World War II and the much sharper curtailment in farm output and in livestock numbers.[1] In fact, were the annual increases in livestock numbers included in total agricultural output, prewar production levels would appear to have been attained even within a shorter period.

Higher levels and rates of agricultural investment,[2] accompanied by more consistent and purposeful formulation and implementation of agri-

* The author wishes to acknowledge the valuable statistical assistance rendered by Mrs. Inga Schueller in the preparation of this note.

[1] See League of Nations: *Agricultural Production in Continental Europe During the 1914-1918 War and the Reconstruction Period*, Geneva, Switzerland, 1943, and Food and Agriculture Organization of the United Nations: *Progress Report, FAO Index Numbers of Food and Agricultural Production*, November, 1950.

[2] All investment estimates in this note refer to new gross investment, since breakdown of net investment by industrial origin is available for only a few European countries. The estimates in Tables I and III relate to investment in equipment and structures, e.g., farm machinery, buildings, irrigation construction, but exclude expenditures on fertilizer and seed. The data presented are not fully comparable, since the concepts on which they are based are not uniform. Thus, in some countries, Hungary for instance, agricultural investment includes expenditures for fertilizer, rural housing, electrification, and road construction. However, as far as possible, an attempt was made to eliminate such conceptual inconsistencies. Nevertheless, for some countries, particularly in Eastern Europe, a certain measure of conceptual error remains.

cultural programs, provide the key to this more rapid rate of recovery. While there are no data on agricultural investment for the early twenties, the evidence based on general qualitative information and scattered figures suggests that levels of agricultural investment were much lower after World War I than after World War II. Rates of farm mechanization and fertilizer application, in particular, appear to have lagged behind current levels.

However, it is not the purpose of this note to analyze postwar rates

TABLE I. AGRICULTURAL AND TOTAL GROSS INVESTMENT IN SELECTED COUNTRIES IN EUROPE FOR 1947–1949

Country	Agricultural Investment			Total Investment			Ratio of Agricultural to Total Investment		
	Millions of 1938 dollars						Percent		
	1947	1948	1949	1947	1948	1949	1947	1948	1949
Belgium	8	12	13	307	326	357	4	4	4
Bulgaria	4	4	—	33	37	—	12	11	—
Czechoslovakia	16	—	—	250	—	—	6	—	—
Denmark	26	28	36	309	313	344	8	9	10
Finland	17	—	—	132	—	—	13	—	—
France	—	273	261	—	2,333	2,470	—	12	10
Hungary	6	15	—	43	107	—	14	14	—
Italy	88	128	133	866	968	1,100	10	13	12
Netherlands	47	55	60	473	538	633	10	10	9
Norway[a]	35	39	42	328	331	363	11	12	12
Poland	50	65	—	291	352	—	17	18	—
Sweden[a]	61	68	67	903	879	842	7	8	8
U. K.	144	158	155	3,710	3,930	4,120	4	4	4

— Indicates data not available.

[a] Excluding forestry and fisheries.

Sources: United Nations Economic Commission for Europe, *Economic Survey of Europe* in 1948 and in 1949.
United States Economic Cooperation Administration, *Country Studies* and *Data Books*.
Annual Reports of the State of Food and Agriculture by member governments to the United Nations Food and Agriculture Organization.
National statistics of the countries listed.

of agricultural recovery, but rather to indicate in general quantitative but nonfunctional terms the interrelationships between investment and output per man and per unit of land engaged in agriculture. This approach is used because an analysis of the net functional relationship between agricultural investment and productivity would be most difficult to accomplish in internationally comparable terms, due to the lack of data and to numerous conceptual problems.

Both total and agricultural investments in Europe have been increasing in every successive year since the war, as is indicated in the data in Table I. While there are no internationally comparable investment statistics for prewar years, such evidence as there is tends to suggest that agricultural

investment in postwar Europe was considerably above 1938 levels.

Agricultural investment, rising from year to year, was accompanied by increasing total investment, as a result of which agriculture's share in the total remained fairly stable in all European countries. However, between countries there was a wide variation in this ratio, from about four percent for the United Kingdom to about 18 percent for Poland.

TABLE II. COMPARATIVE SHARE OF AGRICULTURE IN THE TOTAL LABOR FORCE, IN NET NATIONAL PRODUCT, AND IN TOTAL GROSS INVESTMENT IN SELECTED EUROPEAN COUNTRIES

Country	Proportion of Labor Force in Agriculture	Agriculture's Share in Net National Product	Agriculture's Share in Total Investment
	Postwar Estimates[a] (percent)	1947–1949 Average (percent)	1947–1949 Average (percent)
Belgium	17.0	11.0	3.5
Bulgaria	80.0	44.0[c]	11.5[d]
Czechoslovakia	38.0	—	6.0[e]
Denmark	27.0	17.0	9.0
Finland	57.0	21.5	13.0[e]
France	36.0	22.0	11.0[f]
Hungary	50.0	26.0	14.0[d]
Italy	48.0	30.5	11.7
Netherlands	20.0	12.0	9.7
Norway	26.0	6.5	12.0
Poland	64.0	21.0	17.5[d]
Sweden	21.0	—	7.5
United Kingdom	5.0[b]	5.0	4.0

[a] Based on postwar census data whenever available; otherwise author's estimates based on scattered quantitative and qualitative information about postwar labor force trends and shifts.
[b] Great Britain only.
[c] 1946.
[d] 1947–48 average.
[e] 1947 only.
[f] 1948–1949 average.
— Indicates data not available.
Sources: Same as for Table I and United Nations *National Income Statistics 1938–1948*, and International Labor Office *Yearbook of Labor Statistics 1947–1948*.

It would be logical to expect a high agricultural investment ratio in countries in which farming plays a dominant or major role in the economy, as measured either by the proportion of the labor force engaged in agriculture or by the share of total national product derived from it. On this basis one would expect to find high farm investment ratios in eastern and southern Europe and low ratios in western Europe. This hypothesis is borne out, on the whole, by the data in Table II. Farm investment ratios appear to be highest in Poland, Hungary, Finland, Bulgaria and Italy, and lowest in the United Kingdom and Belgium, countries in which agriculture is least important. However, Norway and

Czechoslovakia seem to be exceptions. Norway is one of the few countries in which agriculture's investment share is larger than its share in total national product. This is largely a reflection of a very substantial farm investment program involving far-reaching mechanization, land clearance, land improvement, and farm construction. Czechoslovakia, on the other hand, had an unusually low investment ratio—only about six percent—while over one third of its labor force was engaged in agriculture, and over one fourth of its national product was derived from it. However, this conclusion is based on data for only one year, 1947, and therefore may not be wholly indicative.

The above data bring out again the well-known fact that in every European country with the exception of the United Kingdom, the share of national product derived from agriculture is lower than the proportion of the labor force engaged in farming. This, of course, is nothing but a reflection of the wide differential in the productivity of labor engaged in agricultural and nonagricultural pursuits. However, at the same time, the table demonstrates the less well-known fact that in every European country, with the exception of Norway, the ratio of agricultural investment falls considerably short of agriculture's share in net national product. To the extent that this reflects a relative neglect of agriculture's investment needs, and to the extent that it is a persistent and continuing condition, it partly explains the relatively low productivity of farm labor, and thus the wide discrepancy between agriculture's share in net national product, and the share of the labor force engaged in it.

It is interesting to note that investment per hectare and per farm worker is lowest in those countries in which there is the widest divergence between the proportion of the labor force engaged in agriculture, agriculture's share in net national product, and its share in total investment (see Table III). Thus agricultural investment per hectare and per worker is comparatively highest in the agriculturally most developed countries; that is, in those in which the capital intensity of farming is already quite high, while it is lowest in the least developed countries, namely, those of eastern and southern Europe.

Unfortunately, there are no internationally comparable figures for total capital stock invested in farm enterprises. Were such data available, they would probably show a close direct relationship between capital invested and productivity of land or labor. Even a comparison of the productivity figures in Table III with data on annual new (gross) investment tends to indicate the presence of such a relationship. Thus, countries which are on the bottom of the investment scale on a per hectare or per male worker basis, such as Bulgaria, Hungary, Poland, and Italy, also tend to be on the bottom of the productivity scale, and vice versa. These trends suggest that if the gap between the more and the less developed countries

is to be narrowed, it is not sufficient for the underdeveloped regions to increase their agricultural investment, but this increase must be at a more rapid rate than in the past and than that of western and northern Europe. However, differential levels of agricultural investment are not only a reflection of varying stages of agricultural development, but also of differing

TABLE III. NET OUTPUT PER HECTARE OF CULTIVATED LAND AND PER MALE WORKER IN AGRICULTURE AND AGRICULTURAL INVESTMENT PER HECTARE OF AGRICULTURAL AREA IN SELECTED EUROPEAN COUNTRIES IN 1947–1949

Country	Net Agricultural Output[a]		Agricultural Investment[a]	
	Per hectare of cultivated area[b] (1938 dollars)	Per male worker in agriculture[c] (1938 dollars)	Per hectare of agricultural area[d] (1938 dollars)	Per male worker in agriculture[c] (1938 dollars)
Belgium	202	510	6.4[e]	27.5
Bulgaria	39	119	0.9[f]	2.9
Czechoslovakia	71	322	2.1	14.3
Denmark	101	797	9.6	88.2
Finland	47	204	6.0[f]	30.3
France	82	400	8.0[g]	62.2
Hungary	49	181	1.4[e]	6.6
Italy	73	192	5.25	18.1
Netherlands	274	604	22.5	100.9
Norway	89	300	37.6	160.8
Poland	51	209	2.8[e]	13.9
Sweden	72	467	14.0	116.6
United Kingdom	118	1,164	7.8	198.8

[a] 1947–1949 average, excluding forestry and fisheries, whenever separate data were available.

[b] Net agricultural output per hectare was calculated on the basis of the cultivated rather than agricultural land area, since inclusion of pastures and meadows may give a distorted picture for some countries. This is primarily a reflection of a wide variation in the quality of pastures and meadows and the intensity of their use in different countries.

[c] The male labor force data in agriculture were obtained either from postwar population censuses, or constitute estimates based on prewar censuses and supplemented by scattered statistics or qualitative information about postwar labor force trends. Male labor, rather than total labor force data were used, since there is a wide variation in the statistical treatment of auxiliary family, particularly female, labor in agriculture.

[d] Since much of agricultural investment is devoted to pasture improvement, total agricultural area was considered relevant for calculating investment per unit of land area.

[e] 1947–1948.

[f] 1947.

[g] 1948–1949.

Sources: Same as Tables I and II.

agricultural programs. For example, countries such as Norway, France, and the United Kingdom, are engaged in large-scale agricultural expansion requiring relatively high investment. On the other hand, in countries in which the capital intensity of agriculture is already quite high, requirements for replacement and depreciation will inevitably absorb a considerable share of available investment resources. Thus, in the Nether-

lands and the United Kingdom, for instance, gross investment per hectare and per worker would have to be relatively high, if only to keep existing capital intact.

The nature and direction of these agricultural investment policies vary, depending upon the special circumstances of each area. Therefore, in areas of labor surplus, farm population pressure, and disguised unemployment, the greatest need is for increasing output per hectare, and investment must be directed towards raising the intensity of farm production per unit of land. This may, for example, involve expenditures for land improvement or increasing of livestock numbers. On the other hand, in areas of labor shortage, agricultural policy may need to be directed primarily towards increasing productivity of labor, and would thus be of a labor-saving character, involving at least some farm mechanization.

A comparison of the postwar trends in European farm production with the long-term programs formulated would tend to indicate that, given average or favorable weather conditions, the targets anticipated in these programs are likely to be realized in a good many countries. However, it is necessary to consider whether this would be enough, in view of the changed world situation which now places new tasks upon European agriculture. This situation reemphasizes the need for increasing regional self-sufficiency and for lower cost production, objectives now warranted not only by balance of payment considerations, but also by the exigencies of defense. Accordingly, agricultural investment would have to be increased beyond the levels currently envisaged. However, under present and prospective conditions, such a program of continuing agricultural expansion is likely to encounter many difficulties.

The post-Korean developments in the full employment economies of most European countries will necessarily require a balancing of competing claims for the available material and human resources between an expanding agriculture, on the one hand, and the requirements of defense industries and armaments on the other. This process is likely to aggravate agricultural labor shortages and thus increase the need for further farm mechanization at a time when farm equipment factories may have to be converted to defense production. Similarly, further expansion of farm production will necessitate increased application of fertilizer and rising rates of fertilizer production, when fertilizer factories may be drawn into the manufacture of chemicals with more direct defense application.

All of this suggests that European countries are likely to face even more difficult problems of investment allocation to the different economic sectors than heretofore, unless present political tensions are substantially relieved.

ALEXANDER ECKSTEIN

Washington, D.C.

SOME PROBLEMS IN MARKETING RESEARCH WITH SPECIAL REFERENCE TO POULTRY PRODUCTS*

RESEARCHERS in the field of marketing face not only the customary problems found in social research, but also many which are peculiar to marketing. The aim of this article is to point out some of these problems and to make suggestions as to possible research approaches, together with certain educational programs which might properly become the end result of research.

At least three characteristics stand out in sufficiently bold relief to warrant consideration: (1) Competition among marketing firms is keen, and the struggle to improve their status is vigorous. Many of them fear that to supply information for research will reveal business secrets and weaken their competitive position. (2) The operations of firms vary so widely that direct comparisons among them may have limited economic significance. (3) If the results of a research project, or the written recommendations growing out of the results, show some types of marketing operations in a bad light, information for future research may be withheld by parts or all of the industry. Indeed, complaints from industry might be so direct as to embarrass the research worker or even the institution he represents.

Faced with these problems, one who pursues research in marketing will need to give major attention toward directing his energies in choosing projects, and in analyzing and presenting the results in a manner so that he can be effective as an educator, and yet maintain the support of industry and of the farmer producers associated with it.

Psychology of the "Laboratory"

The typical, progressive marketing firm strives to increase its efficiencies, reduce its operation costs, improve its competitive position, and thus swell its profits—or reduce its losses. Profits are relatively low in most food marketing businesses, including the poultry and egg business, and the rate of mortality is high. Hence, marketing firms need to be on the alert if they are to succeed.

It seems characteristic of every firm to believe that it possesses certain "business secrets" which must be guarded. Most firms think that if those secrets fall into the hands of others, their competitive advantage will be impaired. The management of the firm may overemphasize the importance of business secrets, and that psychology has seemingly become

* During the preparation of this manuscript, several of my colleagues in the Department of Agricultural Economics, the University of Wisconsin, have made valuable suggestions, for which I express appreciation.

engrained in the minds of competitive business, including marketing.[1] In his desire to protect those secrets the manager of the firm is cautious in giving out information to research workers regarding its operations, especially those involving efficiencies, costs, margins, and profits–the topics around which this article will center its main attention.

The marketing firm is the laboratory of the marketing economist. Hence, the psychology of that laboratory must be kept in mind in formulating and carrying forward a project on marketing, because it serves as a barrier in obtaining the necessary information from which to make analysis, and draw fundamental conclusions on how to improve market operations.[2]

Thus far I have referred only to proprietary firms, not cooperatives. Producer cooperatives are generally more willing to release information to research workers than are proprietary organizations. This is largely because the very marketing specialists or institutions who are asking for the information may have been instrumental in starting the cooperative, or have contributed towards its successful operations. Thus the co-op management has confidence that the information which it supplies will not be used to its disadvantage.

Limitations Due to Lack of Data

Suppose a researcher initiated a project on handling costs, margins and profits of egg dealers–in order to make a detailed analysis he would logically go to the books of the handlers.[3]

Most of the small, and many of the medium size and even large firms, do not have an accounting system adequate to provide a reliable breakdown of these items.[4] Even though the cost figures are available with reasonable accuracy, one is not justified in making direct item by item comparisons between firms because not all firms assign similar expense items to the same category. Thus, in making such comparisons, it is difficult, and in many instances impossible, to obtain valid, meaningful, and

---

[1] On numerous occasions I have found that certain information which some firms look upon as secret is quite generally known to the industry. Perhaps the specific market outlet is the most important secret of a firm.

[2] It is significant that the RMA poultry industry advisory committee has not given its support to cost and margin studies.

[3] In a study on which we are now engaged we have attempted to get the following breakdown of costs: (1) general administrative costs, (2) salaries, (3) wages and bonuses, (4) plant, equipment, and maintenance and repair expense, (5) supplies, (6) heat, light, and water, (7) insurance, (8) taxes, (9) depreciation, (10) rent, and (11) miscellaneous. In Wisconsin we have access to the records from the Assessor of Income offices. However, it is conceivable that such figures could be obtained directly from books of the firms.

[4] Much the same situation prevails for small and medium sized dairy companies, and would no doubt also hold for handlers of other farm products.

strictly comparable statistics between firms. This necessitates more statistical leniency than is generally permitted in some types of quantitative studies.

Need for Discretion in Presenting Controversial Phases

Most of us will agree, I think, that the job of making clear-cut, fundamental recommendations is the difficult and percarious part of a marketing project. Even assuming the specialist obtains the facts and makes logical, economically sound, and objective recommendations, if they are pointed toward controversial issues they may "draw fire" and result in embarrassment to the researcher or even to the institution which he serves.

If the recommendations point out the advantages of certain types of procedures in marketing—for example, those with larger, more integrated and more efficient type of operations—the recommendations will likely not be well received by the smaller and perhaps less efficient handlers; consequently the recommendations may act as a boomerang to future research in the area, at least to the person who carried on the research.[5]

One has only to follow the controversy of the chain store versus the independent store to appreciate the impact of such controversy on the public as well as on legislative bodies. Right now there is a sharp controversy over the advantages to producers (or to consumers) of chain stores becoming direct assemblers of eggs from farms and performing all the marketing operations directly to their counters in the cities.

If a marketing economist has a yen to become a magnet for attention, I suggest that he do a research job in this field and come out with clear-cut positive recommendations either for or against the advantages of marketing eggs from producer to consumer through the integrated chain store system!

The research man in marketing faces quite a different problem from that of the physical scientist. The researcher in the physical sciences may be engaged in controversial problems, but the controversy is generally limited to the cloistered atmosphere of academic halls. Not so with the marketing economist. His laboratory is the going concern of the marketing system. His research involves controversial issues which affect the very taxpayers from whom his income originates.

Positive clear-cut conclusions and recommendations enhance the scho-

---

[5] Needless to say, it is important for a researcher to avoid becoming closely identified with any one kind of organizational set-up. Such association might become especially embarrassing if the results of a project should show that particular type of organization in a better light than its competitors. Maintaining objectivity in "the trade" is virtually as important as objectivity in research.

lastic stature of a research worker among his academic colleagues, but unfortunately those same recommendations may serve to boycott him by the industry. Scholars interpret facts, observations, and recommendations objectively. The entrepreneur interprets them subjectively—his main question is, how do they affect me and my firm? If they show his firm or type of firm in a good light, he concurs. If, on the other hand, he interprets the recommendations as being uncomplimentary to his firm, or type of operation, he becomes disturbed and may back up his disturbance by action derogatory to the interests of the writer of the recommendations.

Situations of this nature, which grow out of many fundamental marketing research projects, places the research man on delicate ground. The job of balancing research, and the recommendations growing out of it, so as to make a scholarly contribution and yet not offend sectors of an industry, is by no means a simple one. Such a balance requires a blend of scholarship and "political finesse" which is not commonly a product of one personality.

The Research Worker as an Educator in the Industry

The researcher is usually able to convey information resulting from research to strategic points by conversation. This may be as effective a way as writing it, and much safer. Indeed, perhaps the most fruitful results of a research study are those which the project leader can use in an educational program as an extension worker among handlers, producers, and students; and perhaps even among his colleagues. Marketing, research, and extension go hand in hand.

In highly controversial issues the long-time research program might be much more effective if the writer reserved his recommendations—or at least the recommendations which might draw fire—to be released in other forms than the bulletin containing the results.

Over the long pull, the amount of information which marketing researchers will be able to obtain from business firms will depend to a great extent upon the confidence which these marketing men, and the institutions they serve, will be able to build up in the industry. As business firms gain confidence in the research being carried on, the psychology of these firms will gradually change—we hope.

Selecting a Project with a View to Improving Industry

In marketing any product at a long distance from the point of production, the operations are a multiphase of activity of considerable complexity. The research worker with limited funds and personnel has the task of determining the points in the marketing mechanism at which he can best direct his efforts in order to obtain the most fruitful results.

In making this selection two related key questions arise, namely: (a) how to determine the area where problems are the most fundamental or crucial, and (b) what is the likelihood that, after the study has been completed, improvements can be brought about?

In egg marketing two significant characteristics stand out: first, a noticeable portion of the marketing costs are due to loss of quality as the eggs move through the marketing channel; second, compared to other farm products, a large part of the marketing costs occurs before the eggs reach the retailer. These characteristics suggest the type of problems as well as the problem areas in need of improvement, and which, if properly analyzed, will likely yield the greatest amount of "pay dirt."[6]

Here are a few practical questions with which egg handlers are faced. At what volume, and under what market conditions, will it be economically desirable to acquire automatic equipment such as egg grading machines, conveyors for moving cartons and cases, and "turn tables" for casing the cartoned eggs? Under what conditions would it pay to possess their own transport trucks? To what extent should a handler move forward on a program of horizontal or vertical integration? Research workers need to be sufficiently well informed so they will qualify as counsellors on problems like these for various units of the industry. *No research man can hope to continue to obtain information from the industry unless he is also able to supply information desired by the industry. Prolonged and productive research cannot be formulated on a one-way road.*

Adopting New Marketing Practices from Research Results

Through a combination of research and extension (educational) work we should be in position to provide effective means of encouraging industry to "adopt new practices" (a phrase well known in extension jargon) which will bring about increased effectiveness in marketing poultry and poultry products. I should think that the industry and administrators of public institutions might agree in principle upon this as an ultimate goal of marketing research.

The adoption of new practices which make for economy of operation takes time. It is the result of considerable effort by both researchers and the industry. Progress is slow. Both the industry and administrators of research programs will need to exercise a degree of patience. Let us not

---

[6] An equally important consideration is that even though research studies may point out the relative efficiency in handling operations, and in maintaining egg quality under different types of organizational set-ups, it does not necessarily follow that the more efficient types provide a greater return to producers or lower prices to consumers. The economic advantages may stay as profit rather than redound to the public.

To an economist an important objective in research—after finding the facts of the market—might well be to determine how the results of economies in the marketing process might be passed back to producers, or forward to consumers.

forget that it took more than a score of years of agricultural research and extension effort to get research information, and to gain the confidence of farmers in our purely production programs. Is there any reason to believe that our research and educational work in marketing can move forward at a much more rapid pace than it has in production? Marketing problems are fully as complex as those in production, and industry is no more enthusiastic about accepting marketing specialists into its fold today than were farmers to accept production specialists when that work was started some 30 years ago.

In the marketing of poultry and eggs, new services are being added from time to time. As eggs of higher quality, more uniformity in size and shell color are requested by consumers, new services and equipment, or more labor, must be added to provide them.

Salesmen are prevailing upon central assemblers and wholesalers to buy improved egg grading machines, to ship their eggs in only new cases, and to pack them for consumers in attractive single-service cartons. With increasing costs of supplies, equipment, and labor, these additional costs may force handlers to increase egg prices to a point where the higher prices will tend to depress consumption. Marketing specialists should be in a position to determine through their research at what point the costs of these services will be greater than the utility added.

Methodology and Exercise of Judgment

It goes without saying that the research methodology used in tabulation and analysis will have to be patterned to fit the job to be done.[7] It will likely be necessary to rely on small samples or case studies. The amount and kind of data assembled will be determined by what is available. If, on the basis of established sampling technique, a minimum of 50 firms would be required, but only 25 can be obtained, then the smaller number will determine in no small part the research procedure and logical and statistical methodology to be used.[8] In many types of studies in the

---

[7] *Method of obtaining data on margins.*—To obtain the margin of a handler it is necessary to obtain both buying and selling prices. On our research we have not been highly successful in obtaining this information on both buying and selling prices from the same handler. Even though they are friendly, and seemingly cooperative, they have a genuine feeling that you are delving into their private business in making this kind of request.

We have, therefore, avoided asking a handler for both buying and selling prices. Instead, we have obtained his paying prices from his seller, and only his selling prices from him. By following specific lots of eggs through the marketing system, we have been able to obtain the margin by getting the buying prices from the one who sells to a handler and only his selling prices directly from him. By using this procedure through the entire marketing system, by grades of eggs, it has been possible to obtain the exact margin of each handler from producer to consumer.

[8] The job of obtaining information from business firms is not an easy one. No matter how carefully the method of obtaining the information is worked out, another factor

physical sciences, as well as in some social sciences, for example, farm management studies, the size of the sample can be increased to the number deemed adequate, if funds are available to make the study. In marketing there is a positive limit within a certain area from which co-operation can be obtained, thus, the statistical sampling method will have to be patterned to meet those needs.

A swivel chair type of *a priori* reasoning which sets up definitions from assumed principles, and deduces consequences from these principles, may have to be altered so that the definitions adopted grow out of the problem at hand. With the latter type of approach it would be necessary that the researcher have a rather clear-cut understanding of the problems involved before the project is undertaken.

W. P. MORTENSON

University of Wisconsin

POSSIBLE SOURCES OF INCREASED AGRICULTURAL PRODUCTION*

THE 1951 level of agricultural production is expected to be the highest in history, but still further increases may be necessary in the years immediately ahead, if serious shortages as well as a tendency for unreasonably high prices of agricultural products are to be forestalled. Even if greatly increased supplies of food are not required for overseas Armed Forces or for aid to foreign nations, the impact of the continued full employment with an accompanying high disposable income will probably create strong pressure for more agricultural goods.

With the population increasing from one and one half to two percent annually, the sheer number of people that are added each year makes a noticeable increase in the need for food. When this increase in population is coupled with the probable greater demand through higher employment, sizable increases in food production are needed. During World War II per capita food production reached an index level of 130.5 with the 1935-39 period as 100. In 1950 this index stood at 119.0, but it would not seem unreasonable that it would need to return to the 1944 level of 130 or above within the next two years if the defense effort proceeds at its expected rate. A total food production index of 157, or 12 percent more than the 140 index of 1950, would be required in 1952 to provide this per capita index.

If, on the other hand, employment should not increase materially and

---

is of equal importance, namely, the personality of the worker calling on the management of business firms. What is required is a combination of methodology and personality, for which we might coin the term "methodality."

* The views expressed are not necessarily those of the Farmers Home Administration.

there should be no noticeable additions to the demand for food by foreign countries and the Armed Forces, it would be possible that the per capita food production index would remain at the 1949 level of 119.4. Even if this should occur, the food production index must need to be 142 in 1951 and 144 in 1952.

In an emergency situation there are a number of means that can be brought into effective operation to increase food production. One important measure is the more nearly optimum use of land and labor resources on land already farmed.

The larger commercial operators with ample incomes at their disposal are probably already producing at or near optimum efficiency,[1] but there remain, according to material prepared for the Joint Committee on the Economic Report,[2] approximately two million farm operator families presently underemployed who could achieve fuller employment through adequately utilizing their resources. If these families could be employed at average rates of production, it would be the equivalent of adding 1.6 million workers to the total working force.

There are, of course, a sizable number of farmers in the lower income brackets who could probably make their greatest contribution to a defense effort by moving into industrial work. In large part, farmers with average farm production resulting in income less than $1,000 in 1949 are on inadequate farm units or are part-time farmers; or because of poor management or for various other reasons, they are not likely to attain the efficiency of the majority of the higher income farmers.

Above this low income group, however, perhaps beginning with those with farm income just over $1,000, there is a high percentage of the farm families on units which can be developed into economic farms. These can attain efficiencies of production approximating that of higher income operators through addition of working capital, the adequate development and enlargement of farms, the utilization of high calibre business organization, and the use of better farm and home management practices.

Records for Farmers Home Administration borrowers provide evidence that farmers in the low income farm groups can make improvements which result in sizable increases in production. Reports from this organization, obtained from operating loan borrowers who have successfully repaid their advances from the Government, show increases in production for the entire group averaging over 60 percent. These families came to the Farmers Home Administration producing agricultural products per acre

[1] Walter Wilcox in his article, "Effects of Farm Price Changes on Efficiency in Farming," *this Journal*, Feb. 1951, refers to the upper 10 percent as operating—"under conditions which most nearly approximate the postulates of economic models."

[2] "Underemployment of Rural Families," material prepared for the Joint Committee on the Economic Report, 82nd Congress, Washington 1951.

of $14 at 1949 prices, and with farm income in the range of $1,000 to $1,500, also in terms of 1949 prices. Those paying their loans in 1949 had average production per acre of $23. This compares with an estimated average production per acre of all farms in the United States in 1949 of $20. Farmers Home Administration real estate borrowers, after five years of operating with guidance from technically trained farm management people in the optimum use of resources, increased their production per acre from $22 to $31 in terms of 1949 prices.

The increased productivity of Farmers Home Administration operating loan borrowers is a result of more nearly optimum efficiency in the use of land and labor resources attained through a more nearly optimum economic combination of amounts of land, labor, working capital, and the utilization of improved business practices. This increased efficiency and improved business organization are attained through inputs of working capital, combined with guidance in management. The working capital inputs are directed toward needed increases in equipment, livestock, and funds to purchase feed, seed, and fertilizer, as well as funds necessary for the improvement of living conditions. The management guidance is directed toward both planning and execution. The loan is approved on the basis of a plan made by the borrower assisted by the supervisor. This plan is to establish an economical type of operation geared to the increased amounts of working capital made possible by the loan. It is designed to insure a sufficient net income for the family to live satisfactorily and at the same time carry out an orderly retirement of indebtedness. At the start of the second or any successive year, or when altering circumstances require changes in the farm business organization, this plan is brought up to date and directed specifically toward the operational period immediately ahead.

A second part of the management guidance consists of follow-up advice for the execution of the planned program of the business, and stimulation of the family to adopt those farm and home practices proved vital to an efficient operation. Real estate loan borrowers receive the same planning and execution management assistance as the operating loan borrowers, plus guidance in the efficient development and utilization of improved land resources acquired through real estate loans.

The original inputs of working capital for operating loan borrowers in recent years have averaged between $1,200 and $1,800. In most instances the original input has been increased by the borrower families, with the result that the total working capital acquired by the family while they have had Farmers Home Administration loans outstanding is considerably more than the original amount of the loan. Estimated average working capital accretions by operating loan borrowers in terms of 1948 valuations are shown in Table I.

TABLE I. WORKING CAPITAL OF FARMERS HOME ADMINISTRATION OPERATING LOAN BORROWERS AT 1948 VALUATION

Area	Prior to Receiving Loan	At Time Loan Was Paid in Full
United States	$1,433	$2,650
East	2,895	5,971
Midwest	1,712	4,659
South	1,120	1,742
West	2,793	5,355

The effect of management guidance on the activities and financial progress of borrower families is difficult to isolate from that resulting from input of working capital, which makes the combination of land, labor, and working capital more efficient and productive. Some reflection of the impact of the stimulation to adopt approved farm practices, however, is shown in Table II, which compares the proportion of operating loan borrowers on the program during the 1950 crop year, following certain approved practices prior to 1950 and at the end of 1950. The proportion adopting improved practices for the entire time they are on the program is of course higher. These figures present a one-year comparison for those on the program during 1950, whereas the average borrower is on the program from three to five years.

If it can be assumed that Farmers Home Administration borrowers are not more receptive to improvement than other farmers in their income

TABLE II. EXAMPLES OF INCREASED USE OF FARM PRACTICES BY FARMERS HOME ADMINISTRATION OPERATING LOAN BORROWERS ON PROGRAM DURING 1950 CROP YEAR

Practices and Area	Percent of Borrowers Following Practices	
	Prior to 1950	In 1950
Use of certified or recommended seed varieties		
United States	23	43
East	33	41
Midwest	32	46
South	19	44
West	24	34
Follow approved crop rotation program		
United States	22	31
East	33	39
Midwest	21	34
South	22	29
West	20	26
Feeding balanced rations		
United States	16	25
East	14	18
Midwest	16	26
South	15	26
West	18	24

range, the increased productivity attained by the former would seem to indicate that a concerted effort to increase the efficiency of all those families below the optimum should result in sizable increases of total agricultural production. Calculations based on Farmers Home Administration records of both operating and real estate loan borrowers indicate that an aggregate production sufficient to increase total production for the Nation by 15 percent could be reached by the group of farmers with incomes between $1,000 and $6,000, if more nearly optimum use of land and labor resources could be attained.

ALMON T. MACE

Farmers Home Administration

SAMPLING PROBLEMS RELATED TO THE STUDY OF THE APPROPRIATE TIME TO MARKET FRYERS*

SOME interesting and practical sampling problems exist in the study of the fryer production enterprise. Given the price-cost relationships, the entrepreneur must accurately estimate the per bird average weight several times during the production period for each lot of fryers that is marketed, if he expects to maximize his net returns, or minimize losses.[1] Furthermore, the entrepreneur must be able to estimate the average weight per bird for the given lot within approximately one tenth of a pound if the selling price and cost relationships are very close at the appropriate time to market, or within two tenths of a pound if the market price is favorable relative to costs.[2]

In that the market price is constant within the range of marketable weights, the producer should be concerned mainly with the construction of his total cost and total revenue schedules.[3] The most profitable marketing weight (in terms of aggregate variable costs) may then easily be determined. The fryer producer must resort to a sampling technique in weight determination because it is not practical periodically to weigh all birds, of say, a 10,000 bird lot. More than one technique may be applica-

---

* Scientific Paper No. 1022, Washington Agricultural Experiment Station, The State College of Washington, Pullman. Project No. 819.

[1] E. L. Baum and H. G. Walkup, "Economic Considerations in Fryer Production and Marketing in the Pacific Northwest," *this Journal*, Volume XXXIII, No. 1, February, 1951.

[2] This general idea was developed in E. L. Baum and H. G. Walkup, "A Further Comment on Profit Maximization in Fryer Production," *this Journal*, Volume XXXIII, No. 2, May, 1951.

[3] Fryers in the Pacific Northwest are classified within the weight range of two and one quarter to four pounds. One market price is most commonly quoted per pound of fryer within this weight range, for any lot.

ble. However, the relative efficiency of each technique should be considered before choosing any one method. Given the cost-price relationships, the poultry-meat producer is confronted with the task of securing a statistically efficient[4] and unbiased[5] sample of the per bird average weight of the whole population (the lot), so that the most profitable marketing weight may be determined. Of course, the entrepreneur must decide on the point of compromise between simplicity of effort (relative costs) and magnitude of sampling error.

Specifically, the problem is outlined as follows: (1) determine the minimum size of sample given the maximum allowable deviation $(\bar{X} - \mu)$ and the critical probability of this deviation (confidence coefficient); (2) determine an unbiased method of selecting the sample of fryers.

The growth schedule with which the entrepreneur is concerned is the per fryer average weight relative to the aggregate variable costs. If the lot of fryers is sampled before the most profitable marketing weight is reached, the most profitable marketing date may be estimated *ex ante*, provided the entrepreneur has accurate knowledge of the distribution of growth schedules for the particular kind of birds under the combination of growing conditions, e.g., feed, temperature, type of housing and the like. The variability of the calculated growth schedule from the modal growth schedule may be determined by successive sampling throughout the growth period. If the particular growth curve appears to be consistent with, but different from the modal curve, then it would be necessary for the entrepreneur to revise his estimate of the most profitable weight to market his fryers.

However, if the grower has no accurate knowledge of the particular family of growth schedules, he must then revert to his currently determined total revenue schedule and total cost schedule per bird in determining the most profitable marketing weight with respect to aggregate variable costs per bird. In this case, the fryer producer must sample frequently during the marketable period until he is certain of being close to the optimum aggregate variable costs-total revenue relationships that will maximize returns or minimize loss for the lot. An inaccurate or inadequate sample at or near the proper marketing date may provide the entrepreneur with information that would result in negative returns, and in some cases unnecessarily force resources out of this industry.

---

[4] Statistical efficiency refers to a sample estimator $(\bar{X})$ of the population parameter (μ) which will have a limiting variance smaller than the limiting variance of any other estimation of (μ). A. M. Mood, *Introduction to the Theory of Statistics*, New York, McGraw-Hill, 1950, p. 150.

[5] Unbiased refers to a sample estimator $(\bar{X})$ of the population parameter (μ) such that the expected value of the sample mean $E(\bar{X})$ is equal to the population mean (μ).

It would be a simple process if the fryer producer could look over his lot of 5,000 to 10,000 birds, or more, and accurately guess the average bird weight. However, our experience in the field has proved that this task is much too difficult. The eyes are quite deceiving when guessing the weights of birds, because of the extreme variability of feathering and conformation among growing birds.

The variability of bird weights within a lot will differ with the source of chicks. Some hatcheries attempt to secure uniformity and good growth features for their chicks as a result of continuous genetic experimentation. These hatcheries closely control their source of hatching eggs. Yet, other hatcheries do not carry on such a program, but manage to sell chicks not on performance, but through small price discounts (about two cents per bird). The producer who purchases his chicks from the latter type of hatchery may not be aware of the large population (lot) variance of fryer weights if he sells his lot of birds on a flock-run basis, and if the lot was not culled closely during the production period. This particular type of producer bears the expense of feeding and caring for inefficient converters of feed and other factors to fryer meat. Does this particular producer maximize his net returns by marketing the larger birds earlier? He could secure answers to this problem by using a dependable sampling technique starting about three to four weeks prior to the appropriate marketing date. This sampling technique would require the producer to weigh each bird individually in the sample to determine the sample distribution by weights.

Many fryer producers buy their chicks straight-run (unsexed). In this situation, the sample must be devised to secure the per bird average weight by sexes, and related weight variability. These findings should provide an adequate guide to the producer as to when the entire lot or each sex ought to be marketed. Too many producers sell their mixed sex lots flock-run, without knowing about the relative output-input efficiency of each sex within the given lot. At the point in time when the males are ready to be marketed, the marginal cost of bringing the females up to the male weight may be greater than the marginal returns. If this were the case, then it would be economically desirable to market both sexes at the same time, although the females are of a lower weight. However, if definite knowledge existed that the marginal cost is less than the marginal revenue for females, then it would be more profitable to market the males and maintain the females to the point where marginal cost is equal to marginal revenue. Each producer would have to determine these relationships through experimentation on his own farm or in conjunction with the local agricultural experiment station.

Sample Size Determination

We realize that the typical fryer producer has not been trained in sampling statistics, hence a practical technique should stress simplicity and accuracy. Can a sampling design be adopted that would enable the producer to take a minimum number of birds in a sample at a given point in time and accurately estimate the per bird average weight of the lot, or each sex within the lot?

The first step in this type of study is to secure estimates of the variance of the bird population weights. Weight variability data available in the literature are quite limited and not too appropriate. Also, known variances of experimental lots may not be representative of lots under commercial operation. The aggressive commercial operator undertakes a strong culling program to eliminate "runts" (birds which inefficiently convert feed into meat), whereas the experiment station investigator does not necessarily (in fact, usually does not) follow this type of program. Therefore, the population distribution of weight within a lot of birds under research conditions may approximate a normal curve, whereas the population distributions found under commercial conditions may be skewed to the right because of culling practices. Some idea of the population variance is necessary to determine the size of the sample.[6]

Fryer weight data was secured from poultry husbandrymen at the State College of Washington.[7] Their experimental data indicate for mixed sex groups at the 11-week age:

---

[6] Assuming that an efficient technique of drawing a simple random sample has been used, the sample size can be determined by the equation

$$n = \frac{t_\alpha^2 s^2}{d^2 + \frac{t_\alpha^2 s^2}{N}}, \quad \text{where} \quad s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(X_i - \bar{X})^2$$

is an unbiased estimate of the population variance (σ^2), and is the variance among the sample items; where ($t\alpha$) refers to the value of (t) corresponding to confidence coefficient (α); where (d) is the maximum tolerable error in the sample mean ($\bar{X} - \mu$) and where (N) is the population size. For a large population (N), and small sample (n) relative to (N), $\left[\frac{n}{N} < .05\right]$, the second term in the denominator can be neglected. An explicit solution for (n) cannot be obtained however, since (n) is needed to supply the (t) value. For the first approximation of (n) it is sufficient to use two digits of the (t) value. If the resulting (n) is less than 30 then a second approximation of (n) using the (t) value corresponding to (n-1) degrees of freedom of the first approximation can be made. From ($n > 30$), a further adjustment is scarcely necessary since the variation of (t) is small for a large number of degrees of freedom.

[7] The weight data was secured from 76 growth experiments conducted by R. Berg, G. E. Bearse and V. L. Miller at the Western Washington Agricultural Experiment Station. All fryers were of the New Hampshire breed.

Experiment I—n = 89, $s_{\bar{x}} = 27$ grams[8]
Experiment II—n = 95, $s_{\bar{x}} = 20.4$ grams
Results from other experiments indicate that the sampling errors fall within the limits of Experiments I and II.

On the basis of the above available information on experimental fryer weight variability, we would have to have a sample size of 212 fryers for $N > 1{,}000$, if we choose $d = (X - \mu) = 45$ grams (0.1 pound), $s = 252$ grams, and $\alpha = .01$. However, if a confidence coefficient of .05 instead of .01 is desired, the minimum sample size decreases to 122 fryers. On the other hand, if price-cost relationships permit us to estimate the per bird

TABLE I. STATISTICAL RESULTS OF 200 BIRD COMMERCIAL FRYER LOT SAMPLES, MIXED SEXES, NEW HAMPSHIRE REDS, 1,850 BIRDS PER LOT, VARYING AGES

Age (weeks)	$\bar{X}$ (grams)	s (grams)	Confidence Limits			n[b]	n[c]
				s (grams)	$s_{\bar{x}}$ (grams)		
7½	904.2	144.2	Upper limit	157.6	11.14	67	10
			Lower limit	133.5	9.44		
8½	952.3	165.1	Upper limit	180.4	12.76	87	13
			Lower limit	152.8	10.80		
9½	1,005.0	185.4	Upper limit	204.5	14.46	108	16
			Lower limit	173.3	12.25		

[a] $P_r\left[\frac{\sum (X_i - \bar{X})^2}{\chi^2_{.05}} < \sigma^2 < \frac{\sum (X_i - \bar{X})^2}{\chi^2_{.95}}\right] = 0.90$, d.f. $= n - 1$

$\chi^2_{.05} = 232.62$ and $\chi^2_{.95} = 167.08$; d.f. $= 199$

[b] Sample size for d = 45 grams at $\alpha = .01$.
[c] Sample size for d = 91 grams at $\alpha = .05$.

average weight within 0.2 pound and $\alpha = .01$, the sample size is 52 fryers; at $\alpha = .05$, the sample size is 30 fryers.

The following statistical results were obtained from the random sampling of three lots of 1,850 fryers each, at a given point in time (Table I). The lots varied in age by one week, and were raised under similar conditions. They were studied under commercial conditions on a typical large

[8] $s_{\bar{x}} = \frac{s}{\sqrt{n}}$; it was assumed that the birds used in the experiments are samples from much larger populations, thus $\frac{n}{N} < .05$ and the finite correction term $\frac{N - n}{N}$ is approximately equal to 1.0. Therefore, the finite correction term was dropped.

scale commercial fryer production enterprise in Washington, using good production practices.

The experimental data were used as a guide in determining sample size. However, we found that the estimated population variability by weight for mixed sexes under commercial conditions was slightly smaller than that shown by the experimental data. This occurrence may be largely explained by the fact that the commercial fryer producer practices an aggressive culling program.

The findings in Table I indicate that the variability between the per bird average weights increases as the birds become larger. The single valued estimate(s) of the variability of the bird weights may be presented as the best estimate of the true population value (σ). However, this procedure does not provide an adequate basis for specifying the degree of confidence that can be placed on such an estimate.[9] Therefore, it is desirable that we calculate confidence limits that will include the true population weight variance with some probable measure of assurance. These confidence intervals were calculated for the three age groups, and the corresponding sample sizes were determined at two levels of probability and accuracy. The findings under typical commercial conditions (relative to experimental conditions) indicate that smaller sized samples usually may be used (with given degrees of accuracy) to estimate the per bird average weight.

The basic assumption underlying a good sampling technique is that of randomness. Hence, any acceptable method must insure this element with a minimum of sampling bias. Our experience and observation indicate that there is constant random mixing of birds in a given house. These birds go in no special direction, nor do any special groups favor any special section of the house.[10] This fact was verified in our case studies of commercial fryer enterprises in Washington.[11] This apparent constant mixing of birds should yield a representative and random sample regardless of where the sample is taken in the house. After observation and consultation with experienced growers, the suggested and most practical method is to place a wire netting, or use some other means that would

---

[9] A. M. Mood, *Introduction to the Theory of Statistics*, Chapter 11, New York, McGraw-Hill, 1950.

[10] Experimental evidence indicates that "pecking order" may exist among mature fowl, but there is no evidence to indicate that this condition exists among immature fowl of the fryer age, c.f. A. M. Guhl, "Some Observations and Experiments on the Social Behavior in the Domestic Fowl," *Kansas Acad. Sci.*, Vol. 47, pp. 337-341, 1945.

[11] Our statistical findings indicate that there is no significant difference of the weight variance between and within trapped groups of fryers selected randomly within a house.

block off a group of approximately 10 or more birds. The size of each group trapped would vary with the sample size desired. All the birds in each trapped group should be included in the sample weight determination, even though the sample size may be larger than desired. We found that great care should be taken to prevent excessive excitement among the birds, because the investigator or poultryman securing the sample is confronted with the problem of "piling-up."

Our investigation of this problem is designed to further study differences in the variability of individual bird weights which result from diseases, changes in climatic and seasonal conditions, differences in farm management practices, and differences in crosses, breeds, sexes and strains in relation to the problem of maximizing profits in fryer production. It is expected that evidence indicating the effects of the above factors on the differences in variability of bird weights will require about three years of further research.

E. L. BAUM AND O. L. BROUGH, JR.

The State College of Washington

TESTING FARM BUSINESS ANALYSIS FACTORS BY CORRELATION

FARM management is the selection of enterprises to fit given amounts of land, labor, and capital, and the operation of these enterprises to produce the greatest continuous profit. We may accept this definition, but how do we tell whether a farmer has made the right selection and is doing a good job of farm operation? Many analysis factors have been developed for use in farm business analysis. Most of these factors are useful but the reliability of some may be open to question.

The usual procedure in analyzing a farm busines is to obtain information about the farm and calculate as many of the analysis factors as is deemed necessary or as many as the available information will permit. The factors calculated for the farm are compared to standards which are based on records from other farms. The relationship between the factors for the farm and the standards indicates the strong and weak points of the farm business. A successful farm is usually considered as one for which most of the factors are equal to or above the standards.

Attempts to relate the various factors to income of the farm operator have commonly been made by sorting farm records into income groups and noting changes in the various analysis factors. The problem has been to determine the factors that were important in causing the change in income. It is generally accepted that size or volume of business is one of

the most important factors determining the level of income, but there is not much agreement concerning the relative importance of other analysis factors.

Problem of Overemphasis

Farm management analysis by sorting farm records into groups and comparing the averages for these groups has been fruitful in pointing out farm success factors. However, there is a problem of overemphasis on one or more factors, depending on the interest of the worker or the problem being illustrated. In many farm management bulletins and reports, the relationship between specific factors and labor income has been shown by tables which have been prepared by sorting on the particular factor. These sorts tend to overlook the effects of other factors and to overemphasize the effect of the sorting factor. It may be true that tables made from these sorts make good talking points for teaching and extension use, but they lead to false impressions that the attainment of a high level in any one factor assures a high income for the farmer.

An illustration of the false impressions that may arise is found in the comparison of Tables I and II which were taken from the departmental files.

TABLE I. LABOR EFFICIENCY AND FARM EARNINGS[a]

Item	Low third	Middle third	High third
Number of farms	142	142	143
Man work units per man	247	328	418
Total man work units	455	553	635
Number of men	1.8	1.7	1.5
Tillable acres	146	159	176
Productive animal units	28	33	37
Machinery investment	$2,947	$3,282	$ 3,266
Gross income	8,641	9,386	10,813
Labor income	2,811	3,556	4,947

[a] Table 9, p. 7. Farm Business Analysis, Area 5, Dairy and General Farming, Michigan State College, Agricultural Economics Department, F.M. 440, May 1949

Table I presents material based on Michigan farm account records for three years. The table was prepared by sorting the records into three groups based on the man work units per man. The impressions left by a study of this table are that income is rather closely associated with labor efficiency and that farms with more man work units per man obtain this efficiency by a higher machinery investment. The differences in the size of farm business are presented but not emphasized.

The material in Table II was prepared by ranking the records according to size of farm business as measured by total man work units, and then sorting into the three groups on the basis of man work units per man. The

results indicate that a medium level of labor efficiency has a slight income advantage over low or high efficiency when size is held nearly constant. There was little evidence of differences in machinery investment among the three groups. However, there was some indication that high labor efficiency as measured by work units per man was associated with some lowering of production rates. This might indicate overexpansion of the business so that the quality of the work and management was reduced.

The comparison of these two tables indicates the confusion that arises

TABLE II. RELATIONSHIP OF LABOR EFFICIENCY TO OTHER FACTORS WITH SIZE HELD CONSTANT

Areas 5 and 8 for 1943 and 1944[a]

Item	Low Efficiency	Medium Efficiency	High Efficiency
Number of farms	195	195	194
Total man work units	516	520	528
Man work units per man	247	298	355
Age of operator	45	43	39
Tillable acres	147	136	142
Machinery investment	$2,717	$2,788	$2,644
Total expense[b]	$5,133	$4,695	$4,368
Dairy product sales per cow	$ 199	$ 201	$ 188
Crop yield index	99	103	95
Gross income	$7,091	$7,322	$6,738
Labor income	$2,056	$2,752	$2,513

[a] Unpublished report prepared by the writer for departmental discussion, Feb., 1946.

[b] Includes operator's labor at $100 per month.

when one analysis factor is used alone. Even when two or more factors are used the results are not conclusive.

Records Used in Correlation Analysis

Early in 1950, a project was started to use correlation methods to test some of the analysis factors commonly used at Michigan State College. The records used in this work were selected from the list of account cooperators who had completed 10 or more years of records. It was felt that the managerial practices of these farmers would be more stabilized and there was also the opportunity to trace each farm for 10 years if the need arose. All of the farms were taken from the counties making up the Detroit milkshed so as to give a reasonable market unity for the major product sold from the farms.

The farms were first classified on the basis of source of income. Only farms with 40 percent or more of their income from dairying were included in the analysis. The farms were further classified on the basis of soil productivity. The farms were identified on soil maps and divided into

three groups based on an evaluation of the inherent capacity of the soil.[1] Soil capacity Group 1 included the most productive soil types with Groups 2 and 3 respectively lower in the inherent capability rating.

Correlation Analysis

The 1948 records for the farms in Soil Group 1 were taken as the basis for testing selected analysis factors by correlation. Labor income was taken as the dependent factor and seven variables were selected from the analysis factors commonly used at Michigan State College. The seven factors used in the study are as follows:

X_1 = Total productive man work units per farm, measuring size of business.
X_2 = Productive man work units per man, measuring efficiency of labor.
X_3 = Total expense for each \$100 of gross income, measuring over-all efficiency and management.[2]
X_4 = Productive man work units per tillable acre, measuring the intensity of the business.
X_5 = Crop yields index, measuring crop production level.
X_6 = Dairy product sales per cow, measuring the production of the major livestock enterprise.
X_7 = Tillable acres per productive animal unit, measuring the intensity of the livestock enterprises on the farm.

These seven factors were studied by the use of correlation techniques to determine the relationship of each factor to labor income and to determine the relationships between the individual factors. After computing the individual relationships, various combinations of the factors were taken and the combined effects studied.

Relationship Between Individual Factors

Significant correlation between the analysis factors used as variables in the study was found in only three cases. Total man work units and man work units per man showed a correlation significant to the five percent point. This correlation bears out the material presented in the comparison of Tables I and II. There was also some correlation between total man work units and expense per \$100 income, but this was slightly below the five percent level desired for significance.

---

[1] Soil capability classification was made by I. F. Schneider of the Soils Science Department, Michigan State College. The general soil types in each class were as follows: Class 1—Brookston, Miami and Isabella (level), and Conover; Class 2—Miami and Isabella (rolling), Fox loam, Hillsdale loam, and Belfontaine loam; Class 3—Belfontaine sandy loam, Berrien sandy loam, Fox sandy loam, and Hillsdale sandy loam. Brady and Bronson loams were class 2 or 3 depending on their associated soil types. Other soil types were also varied depending upon their association.

[2] In more recent reports this analysis factor is given as return for \$100 of expense. This measure gives a more logical input-output relationship and would be positively rather than negatively correlated to labor income.

There was significant correlation at the five percent level shown between dairy sales per cow and expense per $100 income, and between dairy sales per cow and crop yield index. It is difficult to explain whether these two relationships indicate an association between high dairy sales per cow and efficiency in the total farm business, or whether high crop yields lead to lower expense for feed purchases and more liberal feeding resulting in higher milk production. It seems more probable that these two relationships are associated with good management practices on the farm.

Relationship to Labor Income

The extent of relationship between labor income and each of the seven factors taken individually is shown in Table III. The highest correlation was found between labor income and expenses per $100 of income. This high correlation was to be expected because of the nature of the factor used. Expense per $100 of income can be designated as a resultant factor about as easily as it can be classed as a causal factor in farm business analysis. Thus, it is affected by many of the same conditions in nearly the same way as is the labor income.

TABLE III. CORRELATION BETWEEN LABOR INCOME AND INDIVIDUAL ANALYSIS FACTORS

Factors correlated	Coefficient of correlation
Labor income correlated with:	
Total productive man work units	.5955[a]
Productive man work units per man	.2723
Expenses per $100 of income	−.8622[a]
Productive man work units per tillable acre	−.0008
Crop yield index	.2824
Dairy sales per cow	.4638[b]
Tillable acres per productive animal unit	.0014

[a] Significant to the 5 percent point.
[b] Significant to the 1 percent point.

Size of business measured by total man work units was second in extent of correlation. Both size of business and expense per $100 income showed correlation with labor income significant to the one percent point.

The correlation between dairy sales per cow and labor income was significant to the five percent point. It is interesting to note that the correlation between dairy sales per cow and labor income was not highly significant, even though the sample was selected from farms with dairy as a major source of income.

The two factors, total man work units and expense per $100 income,

were shown to have the greatest individual correlation with labor income. Other factors were combined with each of these factors to determine the effect on the correlation (Table IV).

TABLE IV. MULTIPLE CORRELATION BETWEEN LABOR INCOME AND VARIOUS COMBINATIONS OF ANALYSIS FACTORS

Factors correlated	Coefficient of correlation
Labor income correlated with:	
Total man work units and man work units per man	.5955[a]
Total man work units and crop yield index	.6463[a]
Total man work units and dairy sales per cow	.7002[b]
Expense per $100 income and crop yield index	.8720[b]
Expense per $100 income and dairy sales per cow	.8622[b]
Total man work units and expense per $100 income	.9101[b]
Total man work units, expense per $100 of income and man work units per man	.9109[b]
Total man work units, expense per $100 income and crop yield index	.9028[b]
Total man work units, expense per $100 income and dairy sales per cow	.9102[b]
Total man work units, expense per $100 income, dairy sales per cow and man work units per man	.9038[b]

[a] Significant to the 5 percent point.
[b] Significant to the 1 percent point.

The combination of total man work units with man work units per man, or with crop yield index, gave coefficients of correlation between the combined factors and labor income that were significant to the five percent level. All other combinations of two, three, or four factors gave correlations that were significant to the one percent level. Correlations involving more than four factors were not computed, since the individual correlations of the other factors and labor income were so low that little would be gained.

When the two factors, total man work units and expense per $100 income, were combined, the correlation coefficient was .9101. This coefficient compares to the coefficient of .8622 for expense per $100 income taken alone. The correlation was not changed greatly by adding other factors. In fact, the combination of four factors gave a slightly lower correlation coefficient than the combination of the two factors.

Reliability of Formula

The ultimate use of a correlation formula would be that of prediction. In farm management work a reliable formula for predicting the farm income for a particular farm would be invaluable. Such a formula would serve for appraisal as well as for determining the income from a given combination of resources and management. To be of absolute accuracy

there would have to be perfect correlation between the factors used in the formula and the income of the farmer.

The factors used in this analysis showed significant correlation with labor income. When the formulas using different combinations of factors are used to estimate the labor income, their reliability can be measured by the standard error of estimate. This measure indicates the limits above or below the actual means of the sample farms within which two thirds of the estimates would fall. Thus the smaller the standard error the more reliable the formula. A comparison of the formulas used in this analysis is shown in Table V.

TABLE V. RELIABILITY OF ESTIMATES WITH FORMULAS USING VARIOUS COMBINATIONS OF FACTORS

Measure and factors used	Standard error
Standard deviation of mean of labor incomes	$2,981
Standard error of estimate of labor income with formula using:	
Total man work units	2,394
Total man work units and man work units per man	2,394
Expense per $100 income	1,666
Total man work units and expense per $100 income	1,234
Total man work units, man work units per man and expense per $100 income	1,227
Total man work units, man work units per man, expense per $100 income, man work units per tillable acre, crop yield index, dairy sales per cow, and tillable acres per productive animal unit	1,144

The farms in the correlation analysis had an average labor income of $4,071. The range in individual incomes was rather wide giving a standard deviation of $2,981. The value of each additional factor used in the predicting formulas can be measured by the reduction of the standard error of estimate below the standard deviation of the sample.

The formula using only total man work units showed a standard error of $2,394, or a reduction of $587 in the variation above or below the mean. When the single factor of expense per $100 income was used, the error was reduced to $1,666, or a reduction of $1,315 in the error of estimate. The combination of these two factors reduced the error of estimate to $1,234, which is only 41 percent of the standard deviation of the labor income. Adding other factors to this combination brought only a slight reduction in the standard error. When all seven factors were used in the predicting formula, the standard error was $1,144, or 38 percent of the standard deviation. So the use of seven factors added only $90 or three percent greater accuracy to the predicting equation, using the two factors of total man work units and expense per $100 income.

Although the formula using seven factors gave considerable reduction

in the error of estimate, it is not sufficiently accurate to be used on a practical basis. An error of more than $1,000 in estimating the income from a particular farm is not apt to be accepted by farm management workers. However, it does indicate that there is a possibility of developing formulas using other combinations of accepted measures or new measures which would be reasonably accurate.

This analysis indicated that the two factors, total man work units and expense per $100 income, were the only factors tested that had highly significant correlation with labor income. This implies that the effect of these factors should be removed before placing much reliance on other factors of analysis.

The measure of expense per $100 of income is a measure of over-all input-output efficiency of the farm. The reports of the Michigan Farm Accounting Project indicate that there is little difference between the total expenses of high and low income farms. We need to study this relationship more to find how farmers spend their money. This would give some basis for making recommendations on resource use and expense control with different cost and return relationships.

B. R. BOOKHOUT

Bureau of Agricultural Economics

PUBLICATIONS RECEIVED

*Agricultural Credit Department, "Land Mortgage Banks," Bombay, India: Caxton Press, 1951. Pp. 78. Re. 1.

Anderson, Arthur L., "Introductory Animal Husbandry," Revised Edition, New York: The Macmillan Company, 1951. Pp. vii, 701.

Banfield, Edward C., "Government Project," Illinois: The Free Press, 1951. Pp. 271. $3.50.

Baumol, William J., "Economic Dynamics," New York: Macmillan Company, 1951. Pp. xiii, 262. $5.00.

Canoyer, Helen G. and Vaile, Roland S., "Economics of Income and Consumption," New York: The Ronald Press Company, 1951. Pp. xvii, 355. $4.50.

Fisher, Ernest M., "Urban Real Estate Markets: Characteristics and Financing," New York: National Bureau of Economic Research, Inc., 1951. Pp. xxi, 186. $3.00.

*Frauendorfer, Sigmund V., "Relief Measures in Favour of Low-Income Farmers in Europe," Bombay, India: The Onlooker Press, 1951. Pp. 50. Rs. 2-8-0.

Hart, Albert G. and Brown, E. Cary, "Financing Defense," New York: The Twentieth Century Fund, 1951. Pp. xiv, 161. $2.00.

Hart, V. B. and Warren, S. W., "Farm Management Manual," New York: Comstock Publishing Company, Inc, 1951. Pp. 86. $2.00.

Hess, Arleigh P.; Gallman, Robert E.; Rice, John P.; and Stern, Carl, "Outside Readings in Economics," New York: Thomas Crowell Company, 1951. Pp. xi, 877.

*Indian Society of Agricultural Economics, "Readings in Agricultural Economics," Madras, India: Commercial Printing and Publishing House, 1951. Pp. 159. Rs. 5/.

Lundberg, Erik, Ed., "Income and Wealth, Series I," Cambridge: Bowes and Bowes, 1951. Pp. xv, 297. 30S net.

Mighell, Ronald L., and Black, John D., "Interregional Competition in Agriculture," Cambridge: Harvard University Press, 1951. Pp. xiv, 320. $5.00.

Millar, C. E. and Turk, L. M., "Fundamentals of Soil Science," Second Edition, New York: John Wiley and Sons, Inc. Pp. x, 510. $5.50.

Mudgett, Bruce D., "Index Numbers," New York: John Wiley & Sons, 1951. Pp. x, 135. $3.00.

Seltzer, Lawrence H., "The Nature and Tax Treatment of Capital Gains and Losses," New York: National Bureau of Economic Research, 1951. Pp. xxii, 554. $7.50.

---

* Reviewed in this issue.

*Summers, Robert E., "Subsidies for Farmers," The Reference Shelf, Vol. 23, No. 1, New York: H. W. Wilson Company, 1951. Pp. 208. $1.75.

Thomsen, Frederick Lundy, "Agricultural Marketing," New York: McGraw-Hill Book Company, 1951. Pp. x, 483, $6.00.

United Nations, "Formulation and Economic Appraisal of Development Projects," Books I and II, Pakistan, India: Superintendent, Government Printing, 1951. Pp. xiv, 473 and vii, 474 to 780. $3.00 and $2.50 respectively.

Wickizer, V. D., "Coffee, Tea, and Cocoa," Stanford: Stanford University Press, 1951. Pp. xiii, 497. $5.00.

Wilcox, Walter W. and Cochrane, Willard W., "Economics of American Agriculture," New York: Prentice-Hall, Inc. 1951. Pp. xiii, 594. $5.50.

Wilson, Harmon W. and Eyster, Elvin S., "Consumer Economic Problems," Fourth Edition, Cincinnati: South-Western Publishing Company. Pp. viii, 757.

Young, John Parke, "The International Economy," Third Edition, New York: The Ronald Press Company. Pp, xvi, 813. $5.50.

BOOK REVIEWS

Uncle Sam's Acres, Marion Clawson, New York; Dodd, Mead & Co., 1951. pp. xiv, 414. $5.00.

The Closing of the Public Domain, E. Louise Peffer, Stanford; Stanford U. Press, 1951. pp. xi, 372. $4.50.

The economic and social development in the United States has been in no small part influenced by public land policies and programs. Federal land contained natural resources which were exploited to furnish capital for industrialization and the growth of our cities. In our federal land programs–acquisition, disposal, and management–one finds a fascinating account of national policies and objectives. But more important, one can gain insight as to the significance of land institutions and their effect on the nature of resource development.

"Uncle Sam's Acres" and "The Closing of the Public Domain" are both about recent federal land policies and programs. However, they supplement each other. Marion Clawson, Director of the Bureau of Land Management, U. S. Department of Interior, has written an autobiography of a public land administrator. E. Louise Peffer has written a carefully documented account of the reservation and management of federal land–policies and programs which were developed between 1900-1950, and in effect closed the public domain. Both of these books are well done and constitute valuable contributions to the literature in the field. Students of land economics will wish to study them carefully. Clawson gives insight into public land administration not previously written about. Peffer fills in part of the gap in the history of federal land policy that has existed since B. H. Hibbard's book of the 1920's.

Clawson has written "Uncle Sam's Acres" almost as though he were sitting around his office telling about the Bureau he directs. He is attempting to acquaint you with the way a public land agency must operate and some of the problems it faces. The first five chapters are a brief history of federal land policies–"How We Acquired Our Public Land," "How We Disposed of Most of Our Public Land," "Reservation and Conservation of Public Land," "We Buy and Barter Land." Chapter VI describes the location, physical characteristics and value of federal lands and Chapter IX describes the uses. Clawson wisely relates water development to land in Chapter VII, "We Develop Our Water Resources." Chapter VIII describes "The Federal Agencies that Administer Our Estate" and Chapter X, the last, covers "Policies and Politics."

Mr. Clawson's book bears evidence that he is a native of the West and an economist as well as a public land administrator. He has succeeded in pointing up most of the major public land management issues of the day. With considerable insight and knowledge he discussed such questions as:

1. the 160 acre water limitation on public projects (p. 195); 2. the authorization to transmit public power (p. 202); 3. the traditional functional organization of the Federal Government as against the area organization of TVA (p. 380); 4. the role of advisory boards in public land administration (p. 368); 5. The need for inducements to encourage the search for minerals and oil (p. 306). Clawson demonstrates his experience and good judgment in his description of the process by which private rights are established on public land. Determination of these rights have been in the past and will continue in the future to be the heart of the major problems confronting public land management agencies—whether federal or county. Unfortunately, the concept seems difficult to comprehend by economists uninterested in property, and persons not familiar with the West.

"The Closing of the Public Domain" is a thorough and carefully documented book of 19 chapters. Its purpose is to relate "the steps by which the concept of public domain has veered from one of land held in escrow pending transfer of title, toward one of reservations held in perpetuity in the interest of the collective owners, the people of the United States."

The policy shifted for forest lands between 1890 and 1910, for mineral lands by about 1920, and for grazing land by 1934. The Reclamation Act of 1902 is considered the bridge since it contained provisions for land sale (old) to finance the development of land (new). The first seven chapters are concerned primarily with policies and programs for forest and mineral lands. Chapter VIII covers homesteading programs between 1900 and 1920. The remaining chapters are devoted to the change in policy for grazing land and the efforts to maintain it.

Dr. Peffer has accepted the division of our public land policy into three phases, "sale, development, and reservations." Her sections dealing with the development of leasing policy are very well done, since she considers leasing evidence of the shift. Dr. Peffer has shrewd observations of the reaction to attempts to increase the grazing fees by the Forest Service in the 1920's and by the Grazing Service in the 1940's. She gives a rather complete account of the jurisdictional feuds over control of public lands, the Hoover proposal to return the grazing land to the states, the Taylor Grazing Act of 1934, the McCarran investigations, and the Grazing District sale proposal of 1946.

A few minor questions should probably be kept in mind while reading Dr. Peffer's book. (1) In describing the pressures which brought about the reservations of forest land and the conservation movement between 1890 and 1910, she does not mention the public pressures in the Midwest against the wasteful lumbering in the Lake States. (2) The book contains very little description of the national setting of wars, depressions, and industrialization within which the land policies were formed.

RAYMOND J. PENN

University of Wisconsin

An Introduction to Agricultural Economics, Robert C. Ross. New York: McGraw-Hill Book Company, Inc., 1951. Pp. vii, 414. $5.50.

For persons teaching courses in introductory agricultural economics this text will bring a mixed reaction, depending upon what they are trying to do with (or to) students. This text does not appear to be designed for the person who is trying to teach his students to apply the principles of the discipline of economics to the problems of agriculture. Some use is made of the tools of supply and demand in the chapter on prices. But in the chapters on marketing no mention is made of the structure of the markets in which farmers sell and buy in terms of numbers of sellers and buyers, characteristics of the products, conditions of entry, etc., at the several stages of the marketing process. No use is made of the income expenditures or income velocity approaches in explaining the ups and downs in the level of income and employment with the policy implications for agriculture which flow from this type of analysis. In short, the contributions of Chamberlin, Robinson, Keynes, and modern economists in understanding some of the problems of agriculture are completely overlooked. This should be regarded as a serious oversight.

This book also does not appear to be particularly well designed for the person who is trying to teach economic principles for attacking agricultural problems by starting with the description of agriculture first. For example, one of the characteristics of agriculture which is cited is the stability of production in the aggregate through time. The bases for this stability are listed in terms of the number of farmers, limited scope of adjustments, fixed investments, limited acreage, fixed labor supply, biological limits, etc. Roughly, only one page of explanation is utilized, of which approximately one half is devoted to the completely obvious ones of climate, biology, conservation, and technology as they affect production. The economic principles are there, but it is doubtful that they are detailed enough for the student to recognize them or to understand them.

There does appear to be a place for a text such as this in a "survey" course in agricultural economics. Almost all of the interests of agricultural economists are included in one or more chapters. They represent agricultural economic history, price analysis, marketing, cooperatives, foreign trade, agricultural finance, taxation, land use and conservation, farm management, farm records, and rural sociology. This is in keeping with the stated aim of the text to introduce the student to the important phases of agricultural economics rather than to explore all the problems which call for solution (p. 7). Quite aware of the limitations of such broad coverage, the author appears to have managed the subject well.

In making its survey of the field of agricultural economics, the text does a good job of emphasizing that complex problems exist in each of the subfields. Using this text, a skilled instructor could undoubtedly convince

many beginning students that the field has much to offer in the way of interesting, but unsolved, problems. But in order to acquire the tools of analysis, the techniques of analysis, the insights necessary even to begin thinking about attacking the problem, the student must go beyond this book. For those instructors who believe that the introductory course should not be a beginning "problems" course with a heavy dose of principles, *An Introduction to Agricultural Economics* has much to recommend itself.

In the preface of this book the impression is given that it was written from the "agricultural" as opposed to the "economic" point of view. As such, it presents evidence of the dangers which beset that approach to agricultural economics. The "economics" is obscured by the vast amount of descriptive material. This is unfortunate, because agricultural economics means little as a field of study and inquiry unless it is primarily economics. For this reason, the reviewer prefers to approach the subject with emphasis on the principles which are part of the discipline of economics, but is in essential agreement with the author that knowledge of both principles of economics and the characteristics of agriculture as an industry are needed for a broad foundation.

ROBERT L. CLODIUS

University of Wisconsin

Agricultural Discontent in the Middle West 1900-1939, Theodore Saloutos and John D. Hicks. Madison, University of Wisconsin Press, 1951. pp. viii, 581. $6.75.

The authors of this book have given us a detailed historical picture of agriculture's painful adjustment to the unsettled economic conditions faced from 1900 to 1939. Their contention is that the area of discontent centered around the Midwest and that by showing the events in this region they present a picture of American agricultural unrest in general. Events are presented largely in historical fashion, with little or no attempt at economic analysis of the problems or the solutions promoted to ease the discontent.

Mr. Şaloutos and Mr. Hicks were faced with the dichotomy that must confront any historian who attempts to chronicle times marked by movements and ideologies. Should the history be given in chronological order with all the conflicting organizations brought in at once, or should the rise and fall of important movements be treated as separate entities to better show their influence? The authors' answer was both.

Thus, Chapter V is entitled The American Society of Equity; Chapter VIII, The Farmers' Union; Chapter IX, The American Farm Bureau Federation; Chapter X, the Cooperative Movement; and Chapter XIII, The

McNary-Haugen Movement. The result is a long book that tends to backtrack at times. It also achieves, however, a detailed picture of the turbulent foundation upon which our present agricultural policy is based. The book gives a greater proportion of its time to the agricultural problems from 1900 to 1920, and the attempts to solve them, than most. Conversely, only two chapters are devoted to the New Deal and its agricultural programs and personalities. This is undoubtedly an asset, since many can describe events of the thirties easily, while those who took part in events from 1900-1930 are beginning to become scarce and are less venturesome with a pen.

The book should help answer several questions for the student of agricultural policy. The history of repeated failures of farmers to achieve relief through party politics and third party movements should explain the reluctance of the farmers to drop their "farm bloc" for programmatic parties, a reluctance very disturbing to most political scientists who concern themselves with agriculture. Second, the book shows that the New Deal for agriculture wasn't really new at all; in fact, farmers have been promoting most of the ideas in one form or another for nearly 40 years. A postwar projection might even suggest that the Research and Marketing Act of 1946 was merely a continuation of the agitation over the same period against high marketing costs and middlemen in general. And it also may prove, to the disillusionment of some, that economic education is a slow process so that some of the same solutions may be offered for the same problems 40 years from now.

Agricultural Discontent should prove an excellent book for the serious student of agricultural policy. Its detail and wide use of names, dates, and places tend at times to obscure the broad issues which it covers. However, this detail helps give a firmer understanding of men and ideas who helped mold our present policies and the organizations which form them. Although its length may prevent its wide adoption as a text in courses in agricultural policy, parts of it will certainly find a place on many assigned reading lists in such courses.

DALE E. HATHAWAY

Michigan State College

Economic Resources and Policies of the South. Calvin B. Hoover and B. U. Ratchford. New York; The Macmillan Company, 1951. Pp. xxvii, 464. $5.50.

This book is the result of the formation of the National Planning Association Committee of the South in 1946. This Committee felt that more information than was available on economic conditions of the South was needed; consequently a number of research projects were authorized. The

Committee wanted from the first to study alternative economic policies. As policies could not be discussed intelligently without complete knowledge of resources, studies of the two were made together. Data comparisons are somewhat limited as they are based on differences between the South and the non-South.

In the following summary, the 17 chapters are discussed under five headings: Resources, Income, Agriculture, Industry, and Finance.

Resources. The South has advantages over the rest of the country in vacation attractions, water resources, and forests. Water supplies are ample for industrial and residential purposes as well as for inland navigation. Mineral supplies are abundant, but major dependence is upon petroleum, where supplies may be significantly reduced within the next 20 years. The South has approximately 70 percent of the oil reserves and 80 percent of the gas reserves. Significantly, much of the industrial expansion of the Southwest has been based on oil and gas. The South also, with 30 percent of the Nation's forest lands, produces approximately one half of the annual timber growth. There is much opportunity for improvement of forest production, tied in with fire protection, forest insurance, long-term credit, reasonable taxation, and better marketing facilities. The last are extremely poor, particularly for the small owner.

The South has a high birth rate and a moderate death rate. A large share of the population increase moves out of the South in boom times. In depression periods the population stays, bringing about an even higher rate of increase. Significantly, the movement out of the South is greater among the Negroes than among the Caucasians. Although improvements have been great in education and health, the South still lags behind the rest of the country. However, of the people moving into and out of the South, those moving in are better educated and hold better jobs than those moving out.

Income. During the period 1929-1949 incomes of the South made sharp increases in relation to those in the rest of the country. Even so, in 1947 they were just 65 percent of the non-southern average. In the meantime, the share of income from agriculture was decreasing and that from industry increasing.

There are several barriers to economic growth in the South, and there are several conditions commonly but mistakenly recognized as barriers. Southern labor with equal training, equipment, and managerial ability is apparently as efficient as non-southern labor. Freight rate differences are not a major factor affecting southern industry. However, there are relatively few agencies supplying capital funds in the South, and many funds which may be collected in the South are sent out of the area. There is considerable absentee ownership of industry. Furthermore there are little managerial training and industrial research in the South.

The South is becoming less dependent upon foreign trade. Added industrialization and perhaps agricultural policy have changed somewhat the South's point of view on this issue.

Agriculture. Recent southern agriculture is characterized by a decline in cotton, increases in most other crops, particularly tobacco and citrus fruits, and a large increase in livestock. Two major causes for low agricultural income in the South are listed as ". . . high ratio of labor to land and capital" and ". . . poor terms of trade." There is, however, a tendency toward larger units with fewer persons on farms, which has lowered the ratio of labor to land and capital. The authors discuss the effects of several kinds of agricultural policy on the South. Tobacco, which has operated under conditions of a continuously strengthening demand and rigid federal controls restricting planted acreage, is shown as an example of monopolistic competition in agriculture operating with federal aid and encouragement.

Industry. Industry has been increasing in the South more rapidly than in the non-South. Major factors bringing about the expansion include the expanding southern markets, the availability of raw materials, including water, and the labor supply. This expansion of industry appears to be the best opportunity for higher incomes in the South.

Wage rates in the South are less than in other parts of the country. The authors state "So long as the productivity in agriculture remains low, so long as the high rate of population increase continues in the South, progress towards the elimination of the differential depends upon moving labor to industrial capital or industrial capital to labor."

Major industries of the South in order of their importance are textiles, lumber, and food and related products. There are potentials, however, in many other areas—opportunities for small enterprises are good in many fields such as in trades and services.

Finance. The South will not have difficulty in absorbing any funds available for investment in the future. To have what might approach equality of income and resource use in the South, as compared to the rest of the country, the South should have something like one fourth the capital investment in the country as compared to 15 to 18 percent at present.

Public finance in the South is characterized by greatly expanded revenues and expenditures. While property taxes have remained almost unchanged, there have been sharp increases in highway and sales taxes. Income taxes are about the same as in other states of the Nation.

Expenditures by states grew even faster than revenues, largely for financing highways, public schools, and educational institutions. The educational problem is indicated by the fact that the South has a third of the Nation's children and just a fifth of the Nation's income. Many of

these children migrate to other parts of the country.

The writers have done an excellent job in compiling and analyzing information from varied sources. It was a huge task. While at times the reading is like that of statistics, one's effort is more than repaid. The book should be read by anyone concerned with problems of the South and certainly by those who would talk and think about them. One interested in checking on tables, however, may find that sources are sometimes incomplete. There is remarkably little expression of personal feeling, although in discussing a problem of the coal industry they state, "That uncertainty grew largely out of the whims and caprices of one man; a man with no observable regard for the public welfare." Summary sections in all chapters would have aided, as also would a summary and conclusion chapter knitting together the contents.

The book is recommended. More work of this sort is needed, with more analysis. It is hoped that study in this field may be greatly expanded.

ADLOWE L. LARSON

Oklahoma A. and M. College

Subsidies for Farmers, Robert E. Summers, New York: H. W. Wilson Company. The Reference Shelf Series, Volume 23, No. 1, 1951, 208 pp. $1.75.

This book is a collection of short but pertinent articles dealing with various aspects of agricultural programs, price policy, farm and consumer subsidies, and the like. The editor, Robert E. Summers of Columbus, Ohio, ties the book together in an interesting way with running comments introducing each major division.

The book is divided into eight major sections, with a total of 61 different articles abstracted under the various parts. The following facets of farm policy are discussed in the book: "The Farm Problem," "The Role of Prices," "Price Supports," "The Parity Concept," "The Subsidy Question," "The Brannan Plan," "Looking Ahead At Farm Policy," and "The Current Crisis." At the end of the book the author has prepared an excellent bibliography which deals with recent discussions of the subsidy question. Reference is made to a total of 68 books, pamphlets, and documents, and 217 articles and periodicals, including the professional journals.

This book very skillfully performs the difficult task of welding the diverse viewpoints of a large number of authors and commentators into a logical and coherent presentation of the entire subsidy question. There is no central thesis in the book. The arguments presented are by authorities with definitely differing beliefs. Moreover, the editor of the volume can scarcely be accused of choosing selections for inclusion so as to present the subsidy question in a biased light, one way or the other.

If the book can be said to be unanimous on any point, it is that farmers should be protected against severe depressions. The nature and proper extent of this protection is left to the reader, who will draw his own conclusions. Such conclusions will doubtless be colored by his own political and social philosophy. However, he will find the major arguments in the book predicated on the premise of "free enterprise" as opposed to "more government in business."

Although this book does not contain much new to the agricultural economist who has been working in the field of farm policy, it does pull together in a concise, interesting, and easily available form a great deal of current and pertinent reference material bearing on the question. The book should find widespread use among a large number of people working on the "fringe areas of agricultural policy" who do not have time to keep current on the literature, and it will find widespread use as reference material in college courses in agricultural policy. It should also be on the bookshelf of the professional agricultural economist.

EARL L. BUTZ

Purdue University

Measures for the Economic Development of Under-Developed Countries. Report by a Group of Experts. New York: United Nations, 1951. Pp. v, 108. $.75.

This report is an international economic rather than political document. The Economic and Social Council of the United Nations requested that the Secretary-General obtain a report and recommendations from a group of experts on "the problem of reducing employment and underemployment in the underdeveloped countries in the light of the current world economic situation and the requirements of economic development." The group was composed of Alberto Baltra Cortez, Professor of Economics, National University of Chile; D. R. Gadgil, Director, Gokhale Institute of Politics and Economics, Poona, India; George Hakim, Counsellor, Legation of Lebanon, Washington, D.C.; W. Arthur Lewis, Professor of Political Economy, University of Manchester, England; and Theodore W. Schultz, Chairman, Department of Economics, University of Chicago, United States.

This short report is divided into four parts, "Introduction," "Measures Requiring Domestic Action," "Measures Requiring International Action," and "Recommendations." In Part I reference is made to the assignment (quoted above), to the conception of underdeveloped countries as meaning poor countries rather than underdeveloped versus developed countries, and finally, to the conception of the employment problem as being primarily technological unemployment and underemployment. The task

of economic development, then, is the creation of new employment rapidly to absorb workers thrown out of work by machine processes and to absorb surplus workers.

In Part II there is a welcome emphasis upon the measures which the poor countries need to adopt in order to facilitate economic development. It is pointed out that the people and the leaders must desire progress, be willing to pay its costs, and that this desire be made known forcefully and definitely. Attention is next directed to the basis for a decision as to whether a particular enterprise should be public or private. While principles are set forth for determining the role of the government in agriculture and industry—including public utilities, general planning, and commerce—a wide area of decision is permitted to individual governments. This particular chapter (Chapter IV) is well worth reading even by those not interested in foreign economic development.

In the rest of this section attention is given to the development and application of technological improvements, domestic capital formation, the problem of population growth, expansion of educational and research efforts, and finally to the problems of developmental planning including both priorities and techniques.

In Part III, dealing with needed international action, consideration is given to the terms of trade as they affect earnings of foreign currency which may then be used for capital imports. The fluctuations in the prices of international commodities, and the high ratio of exports to national income, place development programs in jeopardy; hence increased stability in terms of trade or net foreign currency earnings is recommended. Price ceilings, if imposed, should apply equitably to both imports and exports in the developed countries. Other measures should be considered. Discussion is also given to policies in industrial countries which involve (1) export dumping and domestic subsidy, (2) making supplies of capital goods available in emergencies, and (3) discriminating against partially processed raw materials in favor of the raw product from underdeveloped areas.

Finally, attention is given to international capital movements. Rough estimates are made of the amount of capital needed to increase national income by two percent annually. The assumptions underlying this estimate need to be considered carefully. The net figure for Latin America, Africa, the Middle East, South Central Asia, and the Far East is about $20 billion, some of which would come from domestic sources and some as international capital. The increase in national income would be divided between advances in levels of living and provision for increased population. It is suggested that about $10 billion annually would need to come from foreign sources after taking domestic measures needed to increase

domestic capital formation. Further, it is suggested that private investment is unlikely to meet the need in many areas where political risks are large particularly as a result of present international conflicts.

Part IV recapitulates most of the above suggestions together with a recommendation for an international development authority established by the United Nations to assist the underdeveloped countries in preparing, coordinating and implementing their programs of economic development, provide and check on grants-in-aid, and to study the progress of the programs.

This review has summarized the report rather than criticized it. This was done because it is a valuable document, one which should be widely read. It is broad in its perspective, comprehensive in its approach, and clear-cut in its findings. Within this framework each of the poor countries could well prepare a several hundred page report giving detailed, specific proposals for implementing its program. No general report can do this detailed job for the diversity represented by India and Venezuela, or Mexico and Indonesia. Detailed, specific, and practical proposals must be developed for individual countries going much beyond the pattern of this report. Any person contemplating work in problems of economic development can well afford to spend several hours studying this report.

LAWRENCE W. WITT

Michigan State College

Trade and Agriculture, A Study of Inconsistent Policies, D. Gale Johnson. New York: John Wiley and Sons, 1950. Pp. vii, 198. $2.50.

I am sorry to find fault with this book. In 194 small pages, it tackles the knotty problem of the conflict between our farm programs and our program of trade expansion. It treats the problem comprehensively. It proposes solutions with courage and ingenuity. But for so great a goal, the book is not careful enough, sometimes not sufficiently restrained, sometimes almost arrogant. It conveys things that makes one wonder whether the author believes in them himself. It should be written again. It could be very good!

Apparently some of the trouble arose because the book was intended to be a semi-popular statement. At least the author says it is "not intended solely for students of economics" but for "any mature person who has an understanding of the broadest aspects of our economic system," although he adds that "a fundamental thread of economic analysis runs throughout." Unfortunately, when I try to look at the book as a "student," I find some of the author's reasoning unconvincing even in those parts of the book where it is adequately presented. When, on the other hand, I make

the greater effort to see with the eyes of the author's "mature person," I believe I find the proposals confused, equivocal, and sometimes of proved political impracticability. The whole thing falls between two stools.

The author puts forward programs as a whole, for both foreign trade and agricultural policy, which he says would not conflict. For agriculture, his program consists of increasing the market for farm products, promoting efficiency in marketing, improving nutrition, *establishing compensatory price or income payments* (for all sectors of the economy—not just agriculture), instituting a system of forward prices, setting up a storage program, and using a "conversion" program to shift people out of low-income areas of production. *He would not support prices, subsidize exports, make government loans, control production,* or the like. For foreign trade policy, he advocates international cooperation for the stabilization of commodity prices. He apparently wants either a buffer stocks or a "commodity reserve" scheme. If the former, he wants it coupled with a system of long-term multilateral contracts, but he would prefer the commodity reserve. He would establish an international agency with authority to conduct integrated price stabilization operations. He would go ahead with the Point IV Program of aid to underdeveloped countries. This is all a little vague, the author being apparently on less familiar ground in the field of trade than in that of agricultural policy.

It would be difficult adequately to comment in a short review on so sweeping a program with so many untested component proposals. It may be useful, however, to dispute a major part of the author's major contention; that is, that his programs would remove the conflict between the two fields of policy and, in particular, that his farm program would not be inimical to the economic interests of other nations. If the price of cotton, say, or sugar, were allowed to seek its level and United States producers were given compensatory payments to maintain their incomes without controls on the amount of their production, a country like Brazil or Cuba would experience a severe blow to its economy. Even a successful commodity reserve scheme could not then save the State Department from a basically much more difficult agricultural policy problem than any it has experienced thus far.

The author may assume that, at the lower price, the world demand for the commodity would be great enough to absorb world supply. He admits, in fact states positively elsewhere in his book, the well-known proposition that, for most crops, even in a free market, price will not satisfactorily equilibrate demand and produced supply. Yet he seems to count on price to equilibrate the two when producers are guaranteed an income. Would they then produce substantially less? I agree that compensatory payments are desirable, but by claiming too much for them the author does a disservice to this proposal.

As for the programs themselves, parts are excellent, but I consider other parts impracticable in any of the specific forms thus far proposed. This is particularly true of the so-called "commodity reserve" scheme, which is a sort of international market-basket dollar or multiple buffer stock. On these matters, there is much critical literature, none of which the author chose to refute or to mention among his elite bibliography.

Were the book's arguments presented more completely, my criticisms could be directed more accurately toward the exact points of disagreement. The problem of trade and agriculture is a great unsolved one in which many are groping for a way out. Detailed intelligent argument is badly needed. Unfortunately, this book relies heavily on flat assertion. Thus, characteristically, the opening chapter states that the author believes that "the isolationist and restrictionist aspects of (United States) foreign economic policy since 1934 have been directly related to agricultural programs. *In practically every instance* (my italics) the need for interference with trade has grown out of the particular needs of a specific agricultural policy." No effort is made to prove this gross overstatement so irritating to one familiar with the economic and trade problems of agriculture. I am reminded of John R. Commons' once telling a group that, whenever a certain Congressional Committee seemed about persuaded to lower a few duties in a bill that later became the Smoot-Hawley Tariff, some free-trade economist would come along with a lecture, and the committee would get angry and leave the rates high.

There are many good—very good—things in this book, but they are presented in a way that could further divide rather than bring closer together the two groups searching, not entirely without success, for a common ground. The author seems not to realize that agriculture's support, more widespread than that of any other major economic group, has been an important factor in maintaining in the United States in the past 17 years one of the most liberal foreign trade policies in the post-1929 world.

ROBERT B. SCHWENGER

Office of Foreign Agricultural Relations

Readings in Agricultural Economics, Nature and Scope, The Indian Society of Agricultural Economics, 1950. Bombay: Pp. 160. Rs. 5/-.

Land Mortgage Banks, Agricultural Credit Department, Reserve Bank of India, 1951. Bombay: Pp. 77. Re. 1/-.

Relief Measures in Favour of Low-Income Farmers in Europe, Sigmund von Frauendorfer. Bombay: The Indian Society of Agricultural Economics, 1951. Pp. 50. Rs. 2/8.

These three publications are dissimilar in conception, scope, and content, yet through them runs a unifying thread. They each exhibit the vigorous and eager interest of Indian agricultural economists in the solu-

tions to agricultural economic problems that have been attempted in countries outside their own.

Readings in Agricultural Economics is a commendable effort by the Indian Society of Agricultural Economics to make available a selected group of readings on the nature and scope of agricultural economics, many from sources that must be difficult for Indian students to come by.

The selections are divided into three groups: "Role of Agriculture in National Economy," "Definition and Scope of Agricultural Economics," and "Research in Agricultural Economics." Manilal B. Nanavati, President of the Indian Society of Agricultural Economics, points out in the foreword that this volume, planned as the first in a series, "is intended to serve as an introductory background to those that are to follow."

The book begins with a brief outline of the plan of organization and of the reasoning that has guided the editors in their problem of selection–a feature that could be copied with profit by the editors of more ambitious collations.

A good sense of balance has guided the editors. For example, selections from O. E. Baker and Ralph Borsodi are followed by J. S. Davis' classic on *Agricultural Fundamentalism;* selected passages from Leonard Salter Jr.'s *Critical Review of Research in Land Economics* are followed by Trygve Haavelmo's survey of "Quantitative Research in Agricultural Economics" from the November 1947 issue of this *Journal.*

A minor defect is the incomplete source citations used in a number of the footnotes; in particular, dates are omitted in several cases.

In *Land Mortgage Banks* the Agricultural Credit Department of the Reserve Bank of India has attempted a survey of the land credit facilities available to farmers in 15 foreign countries. This useful but brief compilation serves as an introduction to a discussion of Indian agricultural credit facilities, their limitations, and possible future development.

The survey of land credit facilities in foreign countries is marred by omission of any discussion of several important programs for aid to new settlers, tenant farmers, and the beneficiaries of "land reform" programs. Discussion of the program of near-100 percent loans to German settlers, developed between the wars in the course of the execution of the Reich Settlement Act of 1919, is conspicuously absent, as is any discussion of the supervised credit programs of the Farm Security and Farmers Home Administration in the United States.

Land mortgage credit in India to date has been almost exclusively a program for consolidating the repayment of past debts. "With the possible exception of Bombay and Baroda, where loans for improvement of land, purchase of land, and similar other objects have been advanced to about 10 percent of their total loans, land mortgage banks in other states have

confined their business solely to the granting of loans for the redemption of prior debts." (P. 73.) Institutional mortgage loans for the purchase of new farms, or for farm improvement, are virtually nil. The private money lender is still the dominant source of rural credit in India.

The problems of mortgage credit development in India can be gauged from the statement that "A well-developed system of land survey and records is . . . the most important prerequisite for the development of land mortgage banking [in India]." (Pp. 70-71.) Though given only fleeting treatment in the final pages of this booklet, it seems obvious that a major demand upon Indian agricultural credit facilities of the future will come in connection with various programs of land tenure reform, strip-farm consolidation, and land development. The Reserve Bank of India has made a promising beginning in developing an awareness of these problems and of their possible solutions.

In *Relief Measures in Favour of Low-Income Farmers in Europe*, Dr. Sigmund v. Frauendorfer of the Hochschule fuer Bodenkultur in Vienna has undertaken a formidable task. By any reasonable standard, farmers in many European countries fall *en masse* into the "low income" class. An adequate description of the governmental measures adopted in their behalf would involve almost the entire range of national agricultural programs. The limitations of 50 pages prevent any detailed treatment of the many policies and programs mentioned. The booklet will be useful primarily as a guide for further study.

PHILIP M. RAUP

University of Wisconsin

World Resources and Industries. Erich W. Zimmermann. New York: Harper and Brothers, Revised edition, 1951. Pp. xvi, 832. $7.50.

Professor Erich W. Zimmermann presents a functional appraisal of the availability of agricultural and industrial materials. The thesis that the manner in which man uses available resources determines his economic well-being leads the author to study the natural, cultural, and human aspects from which the fund of resources evolves. Resources are considered as means (instrumental wealth) to ends (real wealth). The general thesis recognizes the presence of resistances, the overcoming of which absorbs a large portion of instrumental wealth, leaving only a residual (*net resources*) for the promotion of real wealth. His functional approach to resources considers a balanced examination of geographical, economic, historical, sociological, technological, and political aspects of world resources and industries—a departure from the traditional treatment.

The present edition is a revision of an earlier one published in 1933. A close inspection of the two editions shows that the newer presents (1) a

fuller and clearer presentation of his functional approach to resources, (2) a superior organization of the material, and (3) up-to-date statistics and other factual data.

This reviewer is in general agreement with the author's interpretation of resources and his rejections of numerous misconceptions of their meaning. For example, he criticizes the strong tendency to identify resources only with substances or tangible things. While substances can function as resources, intangibles such as health, social harmony, wise public and private policies, knowledge, and freedom may be more important. One should study resources as evolving out of the dynamic interaction of both the tangible and intangible factors. Other misconceptions are: (1) the tendency to think of resources in terms of a single asset, e.g., petroleum, rather than the whole complex of substances, forces, conditions, relationships, institutions, policies, and the like, which help to explain how petroleum functions as a resource at a given time and place; (2) the idea that resources are static and fixed, whereas they should be considered as dynamic; and (3) the failure to realize that there must be resistances where there are resources.

The word "resource," Zimmermann says, does not refer to a thing or a substance but to a function *which it may perform or to an operation in which it may take part,* namely the function or operation of attaining a given end, such as satisfying a want. It is proper to view the word "resource" as an abstraction reflecting human appraisal and relating to a function or operation.

Although the thesis recognizes the importance of the dependability of national resources in the long-run and the social implications thereof, the text omits a discussion of the basic concepts of welfare economics and the theorems dealing with welfare maximizing criteria in attaining efficient resource use. The field of welfare economics, although relatively new and somewhat abstract, is relevant, especially in the functional treatment of resource use.

The study of this book enables the student of economics to develop a more comprehensive understanding of the physical and cultural bases of living. Detailed information is presented to illustrate principles and general functional relationships. One of the book's chief assets is that the author is concerned with interpretation of statistical data and trends rather than the reproduction of data readily available elsewhere.

Part II and Part III deal, respectively, with the resources of agriculture and their utilization, and the resources of industry and their utilization. These two sections form the major part of the book (549 pages). The 38 chapters included here illustrate the principles of functional correlation

established in Part I and further develop the author's philosophy regarding resource study.

Parts II and IV are of particular interest to the agricultural economist, because of the discussions of the operation of the forces affecting the supply and demand for agricultural products and the treatment of agriculture in an industrial world. The stress placed on any particular chapter or group of chapters would depend upon the reader's interest. The development of each chapter, e.g., foods and foodstuffs, animal and vegetable fats and oils, are timely and adequate for this type of general text.

Part IV deals with resource problems, such as conservation and its economic and social implications, conservation and technological progress, and resource adequacy. In this section are presented the problems of predicting the future and the conflict between present and future interests. The distinction between economy in resource use and conservation is well made. Conservation is defined as being concerned with *a reduction of the rate of disappearance or consumption,* while resource economizing does not necessarily affect the rate of consumption but *expresses the ratio of input to output or of sacrifice to benefit.* Whether economy in resource use results in conservation depends upon the nature of the industry (degree of competition) and the elasticity of demand for the products of the particular industry.

Professor Zimmermann presents a scientific method of resource study and appraisal. This type of an account ought to have greater permanent authenticity than one of a strictly quantitive nature (devoid of the analytics). This book is an excellent starting-off point for the economics student in resource study because the up-to-date footnote references and first-rate bibliography guide the reader to an abundance of excellent source material.

World Resources and Industries is a distinguished book in its field because it presents and discusses resource utilities rather than mere physical units, thereby transcending the conventional conception of resources as something that can be adequately shown in statistical tables. It should be very useful not only to the "college" student in economics, but to all people concerned with present and future production potentials in the higher echelons of national and international policy. A timely and valuable contribution to the economists' literature, it builds up the structure which shows how the nature and extent of resources and the utilization provide the key to production—and production has now become the key to survival in our dynamic but unstable civilization.

E. L. BAUM

The State College of Washington

NEWS NOTES

AWARDS FOR 1952

The American Farm Economic Association will make the following awards in 1952: (1) Award for the best article published in the *Journal of Farm Economics* in 1951, (2) Awards for published reports of research in the field of Agricultural Economics, and (3) Awards for theses submitted in partial fulfillment for the degree of Doctor of Philosophy in departments administering majors in Agricultural Economics.

Award for Best Journal Article

For the article judged best among those published in the *Journal of Farm Economics* during the calendar year 1951 an award of $100 will be made. The selection will be made by the Editorial Council.

Awards for Published Reports of Research in Agricultural Economics

1. For the year 1952 there will be three awards of $250.00 each. Each award will be in a different field of Agricultural Economics.

2. Publications including books, bulletins, articles, and pamphlets submitted for consideration will be classified in the following fields, and persons submitting items should indicate the field in which they believe the reports should be classified.

(a) Farm management and production economics
(b) Agricultural marketing
(c) Agricultural prices
(d) Agricultural finance
(e) Land economics
(f) Theory and methodology
(g) Agricultural policy

3. Selections will be made from published research bearing the publication date of 1951.

4. Only publications prepared by persons 40 years of age or less at the time of publication will be considered.

5. Reports of research published in the *Journal of Farm Economics* by persons 40 years of age or less at time of publication shall be eligible both for an award for published research and for the best *Journal* article.

6. The Awards Committee for Published Reports will be made up of seven persons, in addition to the Chairman, representing the various fields which have been designated. The members of the Committee, all of whom are members of the American Farm Economics Association and will serve as judges, are: E. O. Heady, H. G. Hamilton, E. C. Johnson, K. H. Parsons, David MacFarlane, William H. Nicholls, and G. E. Brandow.

7. Publications must be in the hands of the Chairman of the Committee, Harry C. Trelogan, Agricultural Research Administration, U. S. Department of Agriculture, Washington 25, D.C., on or before *February 1, 1952*. Eight copies of each publication entered are requested, but fewer copies will be accepted in such cases as articles appearing in national journals or books otherwise available to the judges. In no event should less than three copies be sent.

8. Members of the Awards Committee for Published Reports will not be eligible to submit papers of their own.

9. Announcement of the awards will be made on or before the time of the 1952 annual meeting of the American Farm Economics Association.

Awards for Ph.D. Theses

1. For the year 1952 there will be three awards for Ph.D. theses of $250 each.

2. Theses in any field of Agricultural Economics may be submitted. Theses prepared by candidates for the Ph.D. degree in any department of Economics or Agricultural Economics in the United States are eligible for consideration, when submitted by the head of the department in which the work was done. No department, however, may submit more than one thesis.

3. Selections will be made from theses submitted to a graduate school faculty during the calendar year 1951.

4. A published Ph.D. thesis may be entered in either the published report or the Ph.D. thesis classes, but shall not be eligible for both awards.

5. Theses must be in the hands of the Chairman of the Committee, Harry C. Trelogan, Agricultural Research Administration, U. S. Department of Agriculture, Washington 25, D.C., on or before *February 1, 1952.*

6. The theses awards committee will be made up of three persons in addition to the Chairman. The members of the Committee, all of whom are members of the American Farm Economics Association and will serve as judges, are: O. C. Stine, John A. Baker, and R. J. Saville.

7. Announcement of the awards will be made on or before the time of the 1952 annual meeting of the American Farm Economics Association.

G. H. AULL, *President*

Note: The Awards Committee solicits the cooperation of members of the Association in encouraging participation in the program. Recognizing the reluctance of some authors to enter their own published reports, members may encourage them to do so, or arrange for others to submit published reports on behalf of eligible authors.

Announcements of the Awards Program suitable for posting are available upon request to the chairman of the Committee.

See inside of cover page of Proceedings issue of the Journal for the announcement of the 1951 winners.

Helen Abell, who has recently completed her work for a Ph.D. degree at Cornell University, has joined the staff of the Agricultural Economics Division at Ottawa to undertake research in rural sociology.

Thurston M. Adams has been appointed Acting Associate Dean and Director at the University of Vermont while Paul R. Miller is on leave for work with ECA in Portugal. Professor Adams will continue as Chairman of the Agricultural Economics Department in addition to his new duties.

William H. Alexander, assistant economist at the University of Louisiana, has been granted sabbatical leave to do graduate work at the University of Illinois.

Elmer F. Baumer has been appointed Assistant Professor of Agricultural Economics and Rural Sociology, Ohio State University. He will have charge of teaching and research in dairy marketing.

Murray R. Benedict is on leave from the University of California until July 1952 to serve as Director of the Twentieth Century Fund's research program, "Analysis of Farm Programs in the United States."

Merrill K. Bennett, Executive Director of the Food Research Institute of Stanford University, is on sabbatical leave from August 31, 1951 to September

1, 1952. He is serving as N. D. Anderson Professor of Economics at The Rice Institute in Houston, Texas.

Bill Bolton and Roane Hathorn were appointed research associates in the Department of Agricultural Economics at the University of Louisiana, August 1, 1951. Mr. Bolton will do research in farm management and Mr. Hathorn will work on a new rice storage project.

C. A. Bonnen, of the Texas A. and M. Department of Agricultural Economics and Sociology, is serving as general chairman of the committee working on the Texas portion of the National Productive Capacity Study.

Lawrence A. Bradford, Professor of Farm Management, has returned to the University of Kentucky after spending a sabbatical leave writing, in collaboration with Glenn Johnson, a textbook in farm management, to be published by John Wiley and Son.

William T. Butz, who received his Ph.D. degree at The Pennsylvania State College in August, has been added to the agricultural economics staff of that institution.

C. E. Clark has resigned as Extension Specialist in Farm Management at North Carolina State College to take a position with the Federal Reserve Bank of Atlanta.

James H. Clark has returned to West Virginia University after a year of graduate study at the University of Minnesota.

Willard W. Cochrane, formerly of The Pennsylvania State College, joined the staff of the University of Minnesota in August, 1951.

A "Conference on World Land Tenure Problems" at the University of Wisconsin, October 8 to November 17, 1951, was attended by experts on land tenure and leaders in agricultural policy from about 40 nations. Sponsors of the conference were the Economic Cooperation Administration (Marshall Plan), the State Department (Point IV Program), the United States Department of Agriculture, and the University of Wisconsin. Plenary sessions met four mornings weekly, evening sessions twice weekly, workshop seminars met four afternoons each week, field trips were made to Wisconsin farms; and after the conference adjourned, a major field trip was made via the Cotton Belt and the TVA to Washington, D.C. Proceedings of the conference will be prepared.

Thomas P. Cooper, who has served as Dean at the University of Kentucky for 33 years, received a change of work status upon reaching the age of 70, and was made a Professor of Agricultural Economics.

John M. Curtis, formerly of Virginia Polytechnic Institute, has joined the staff of North Carolina State College.

Vance W. Edmondson was appointed assistant professor in the Department of Rural Economics and Sociology, University of Arkansas, effective September 1. He was formerly of the staff of Oklahoma A. and M. College, and in 1950 had a year of graduate study at the Royal College of Agriculture and Veterinary Science, Copenhagen, Denmark.

Homer C. Evans has been granted a year's leave of absence from West Virginia University to do graduate work at the University of Minnesota.

W. F. Ewert, statistician of the Dominion Bureau of Statistics, Ottawa, has accepted an FAO appointment for a year's service in Chile.

Kenneth E. Ford is on sabbatical leave from the Georgia Experiment Station to do graduate work at Michigan State College.

J. A. Galbraith, until recently employed by the Canada Department of

Labour, has joined the staff of the Economics Division, Department of Agriculture, Canada.

C. R. Harston, of Washington State College, has accepted an appointment as assistant professor at Montana State College. He will continue the research in livestock marketing begun by C. B. Brotherton, who has been called to military service.

Dale E. Hathaway, extension economist at Michigan State College, after a year at Harvard spent the summer on an assignment with the Division of Agricultural Economics. He was with Dr. L. M. Vaughan on extension work in agricultural policy questions, an activity carried on in cooperation with the Farm Foundation.

W. E. Hendrix is now stationed at North Carolina State College, working for the Committee of the South of the National Planning Association. He is studying problems of low productivity in agriculture in the South.

Asher Hobson, University of Wisconsin, was re-elected Chairman of the Board of Trustees of the American Institute of Cooperation at the Logan, Utah, meeting.

John A. Hopkin, who has been on leave the past year completing work for his Ph.D. degree at Iowa State, returned to the University of Wyoming September 1.

Edgar A. Hyer, assistant professor, Oregon State College, resigned in September to accept a position at California State Polytechnic College.

V. L. Israelsen was granted a leave for a second year from Utah State Agricultural College to continue his work with the Federal Housing Administration in Puerto Rico.

Hilliard Jackson has returned to the Department of Rural Economics and Sociology, University of Arkansas, as Assistant Professor of Livestock Marketing, after completing the residence requirement for his Ph.D. degree at North Carolina State College.

Glenn L. Johnson, University of Kentucky, is a visiting professor at Michigan State College during the fall term, 1951.

Robert C. Jones, during many years of research, has compiled a bibliography on Mexicans in the United States; the work will be published by the Legislative Reference Service of the Library of Congress.

Edmond Lebrun, assistant professor, University of Maine, has been granted six months' leave of absence to work for the Office of Price Stabilization, Washington, D.C.

Wayne A. Lee, Associate Professor of Agricultural Marketing, returned August 15 to the Pennsylvania State College after a three-month leave of absence to act as economist and later Head of the Frozen Fruit and Vegetable Section of the O.P.S.

Fred F. Lininger, formerly Head of the Department of Agricultural Economics and Rural Sociology at the Pennsylvania State College, and now Director of the Agricultural Experiment Station, has been granted a year's leave of absence to serve as chief of the Agricultural Institutions and Services Branch of the FAO, in Rome.

Gale Lyon resigned his position as assistant agricultural economist with the West Virginia Agricultural Experiment Station on June 30, to accept a position with the Federal Crop Reporting Service at Charleston, West Virginia.

Lewis D. Malphrus has returned to his position as assistant agricultural

economist at the South Carolina Experiment Station after more than a year of graduate study at Purdue University.

W. C. McArthur, Texas A & M College, has been reassigned from farm management research to the marketing research program of the Department of Agricultural Economics and Sociology.

W. E. McDaniel, who has just completed the requirements for his Ph.D. degree at the University of Minnesota, has accepted a position as assistant agricultural economist, University of Delaware.

Wendell McKinsey, professor at the University of Missouri, has been granted leave of absence to spend the next school year in study at the University of Chicago.

Joseph F. Metz, Jr., has been appointed to the agricultural economics staff at the University of Vermont. He will teach Professor Story's Courses while the latter is on leave for graduate work at Cornell University.

Paul R. Miller, Associate Dean and Director at the University of Vermont, is on leave for work with ECA in Portugal.

Leon E. Moberg is on leave of absence from the Soil Conservation Service, Chandler, Arizona, to do graduate work at Oregon State College.

Clarence A. Moore, formerly of the Alaska Experiment Station staff, has been appointed temporary assistant professor in the Department of Economics and Sociology at Kansas State College during the absence on leave of Joseph W. Koudele.

Earnest M. Morrison, Utah State Agricultural College, has been granted a sabbatical leave of absence to pursue graduate study at the University of Illinois.

L. S. Paine represented the Texas A. and M. Department of Agricultural Economics and Sociology this year at the Fourth Annual Symposium on the Grain Trade held in Chicago September 6 and 7.

H. F. Patterson, of the New York and New England Apple Institute, was appointed July 1 to the position of extension marketing specialist at the University of Rhode Island.

Dudley L. Peery, who recently received a Master's degree at Iowa State College, has joined the staff of the South Carolina Experiment Station as assistant.

Ray Pengra has been appointed assistant economist on the staff of the South Dakota Agricultural Experiment Station.

Walter H. Pierce has returned to North Carolina State College after completing the academic requirements for his Ph.D. degree at the University of Minnesota.

Ward F. Porter, Jr., of the Department of Agricultural Economics and Rural Sociology, West Virginia University, was awarded a Ph.D. degree, with a major in Sociology, by Harvard University in June.

T. S. Rackham, for several years with the Economics Division, Department of Agriculture, Ottawa, has resigned to accept an appointment with the School of Agriculture, Vermillion, Alberta.

John C. Redman, formerly associate professor at Mississippi State College, received his Ph.D. degree from the University of Kentucky this summer and will remain on the teaching and research staff.

R. R. Renne, of Montana State College, has been granted a year's leave of absence to serve as Chief of Mission of the Economic Mission to the Philippines.